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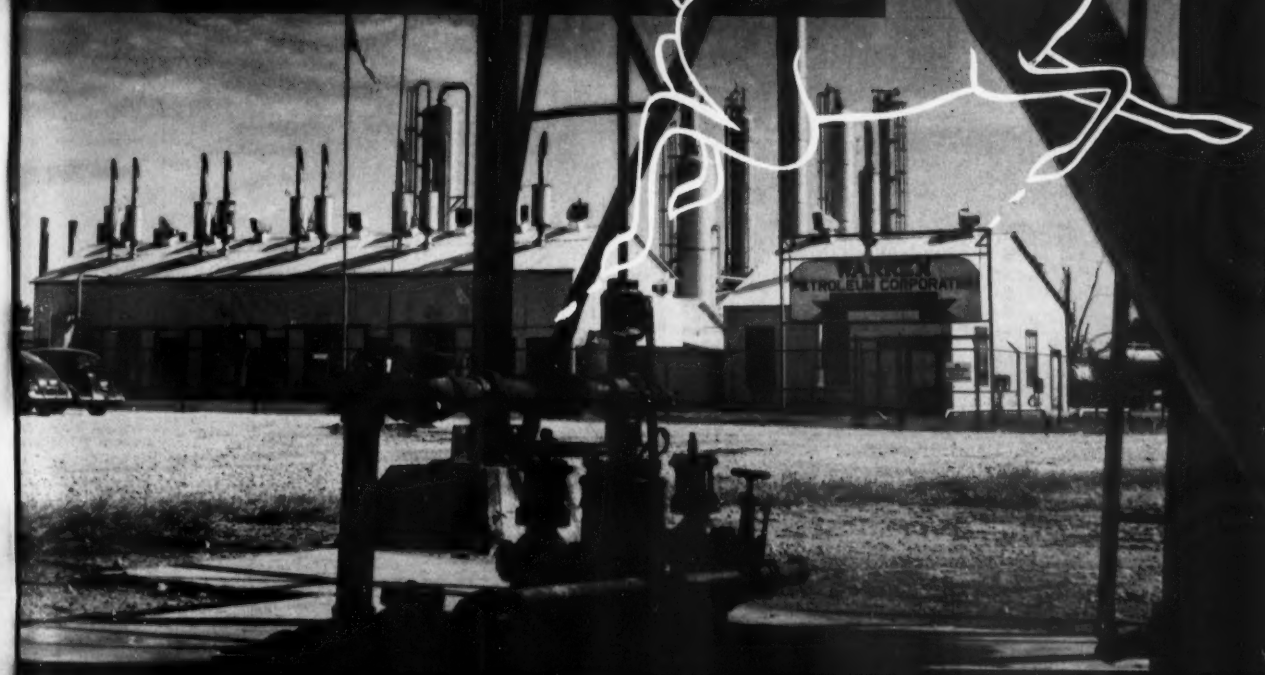

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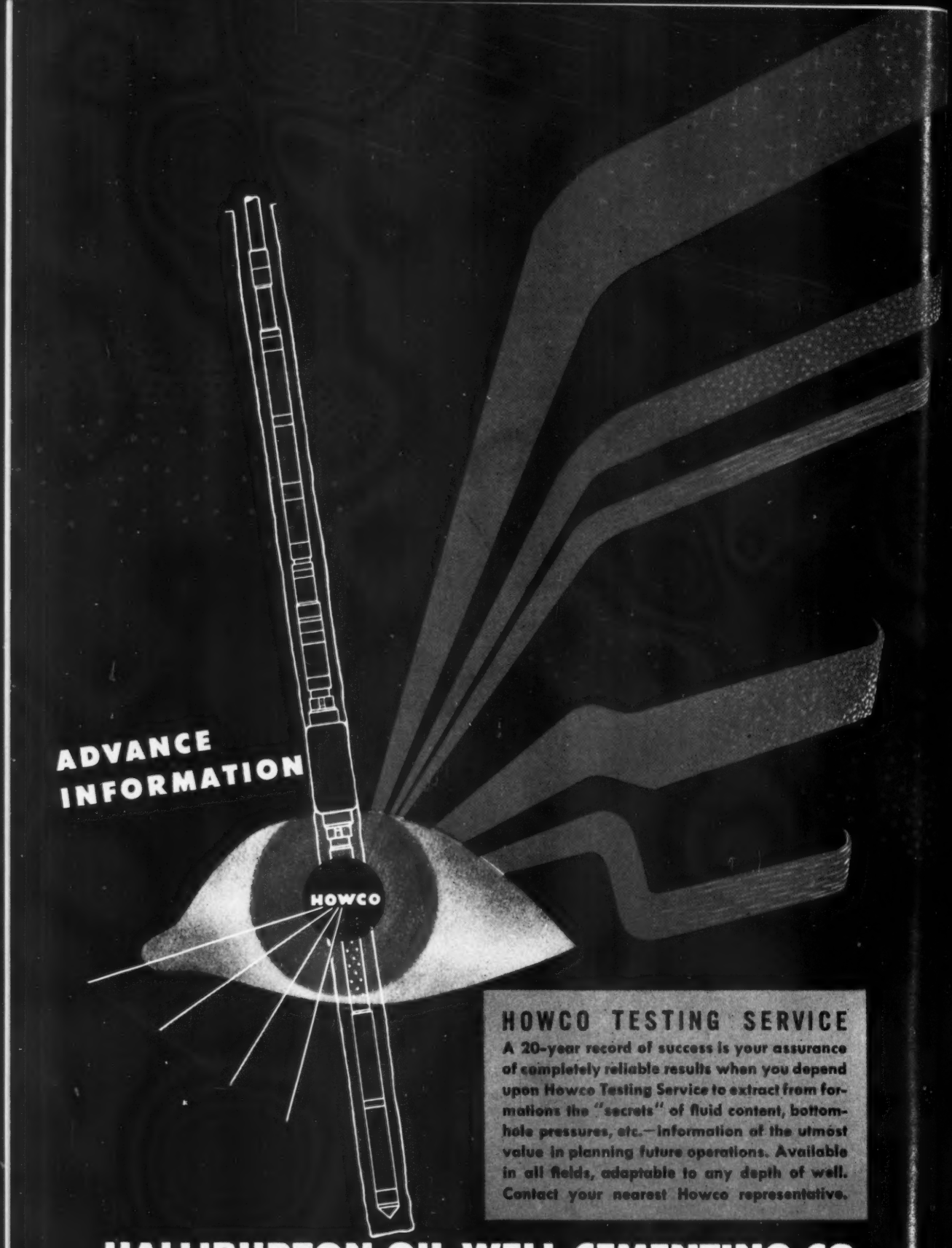

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Subscription rate to the petroleum industry, United States and foreign, 1 year, $3.00. Single copies, 20 cents. Back copies, when over a year old, 50 cents. Note: Payments from outside the U.S.A. may be in the form of an international money order or check on a U.S.A. bank. Entered as second-class mail matter at Tulsa, Okla., under Act of March 3, 1879.

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Vol. 46, No. 47 March 25, 1948

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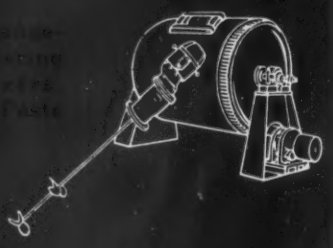

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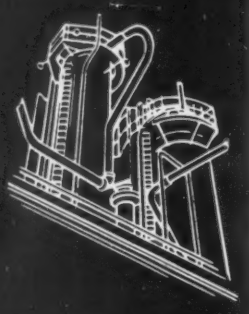

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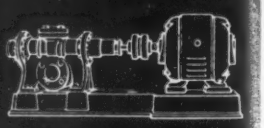

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THE OIL AND GAS JOURNAL

Light Hydrocarbons

IN the summer of 1940 natural-gasoline manufacturers generally were wondering what, if anything, could be done about their business. Over a period of several years they had become accustomed to low prices, but during that summer quotations dropped so low that many sellers started offering their products on a barrel basis instead of the usual gallon.

Thousands of tank cars of the principal grades of natural gasoline sold for 50 to 60 cents per barrel at the plants, or approximately half the prevailing posted price for high-gravity crude oil in the Mid-Continent.

But gasoline manufacturers from the beginnings of their division of the oil industry have always been confronted with constantly changing problems, and the 1940 operators, with few exceptions, kept their plants operating around the clock. Costs were lowered, storage capacity was greatly increased to help bridge the gap in seasonal consumption of their products, and sales departments expanded existing markets and found new outlets.

As a result, times have changed. Production of natural gasoline and related products is now more than twice what it was 8 years ago, and there is a ready demand for every fraction available. The gloomy prophets of what was to happen to natural gasoline "after the war" have had to look to other fields as an outlet for their pessimism.

The Journal's annual survey, one of the features of this issue, shows that there are 464 natural-gasoline plants and 49 cycling plants in operation with a capacity of nearly 20 million gallons daily. Approximately 50 major projects involving new plants or additions to existing units are under construction or have been authorized. This new construction will add 12 or more per cent to current output. Further expansion is assured as the required equipment and materials become available.

We are particularly impressed with the fact that nearly 40 per cent of the present output of more than 500 million gallons monthly is consumed as liquefied petroleum gases. This record far exceeds the most optimistic predictions of pioneer natural-gasoline manufacturers of two decades ago.

A majority of today's operators can readily recall the time when propane output went to their fuel lines or was flared, and when butane sales at 1 to 2 cents per gallon were largely confined to the winter months. Today the mixtures, consisting principally of these products, for use as liquefied gas supply approximately 20 per cent of all homes using gas, and this market has doubled in the past 3 years.

Briefly summarized, this amazing record applying to all light hydrocarbons is another reflection of what the oil industry has been able to do in extending its services to consumers. It also presents further proof of the significance of adequate price in enabling expansion of those operations which are now a major contribution to the industry's conservation program.

Field Shutdown Orders Possible As Seeligson Injunction Ended

by Dahl M. Duff

AUSTIN.—The way was apparently cleared last week for the Texas Railroad Commission to proceed with shutdown orders against fields flaring excessive casing-head gas.

Roy C. Archer, 126th District Court judge, here March 16 dissolved a temporary injunction which for almost a year had blocked the commission from enforcing an order shutting down Seeligson field in Jim Wells and Kleberg counties until casing-head gas was put to legal use.

Commission officials considered the Seeligson injunction suit a test case, and possible action against 14 other fields was held in abeyance while it was pending. Information here last week was that the commission has not yet decided on its next steps now that the Seeligson case has been disposed of.

The Seeligson suit was filed by 11 operators in the field March 27, 1947, after the commission issued an order effective April 1, 1947, closing in operations until casing-head gas was utilized for light and fuel, cycling, repressuring, or natural-gasoline manufacture. The companies contended difficulty in obtaining materials had delayed construction of an extraction plant.

Broad Authority Exists

The commission's broad authority to issue such an order was upheld in a decision by the Texas Supreme Court last November. However, the high court declared that each field presented a separate problem and left the injunction against the commission in effect until the case was tried in District Court on the issue of whether the commission's order was reasonable as to Seeligson *(The Oil and Gas Journal, January 15, page 44)*.

Most of the questions had become moot from a legal standpoint when the Seeligson trial was called last week in District Court. Limited operations have been commenced at the Seeligson plant, and much of the gas is now being utilized, though some 38,000,000 cu. ft. was being flared at the time of the issuance of the order.

The operators filed an amended petition charging that the order was invalid on the additional grounds that it failed to take into account certain necessary flaring of gas due to line losses and compressor breakdowns. The state contended this was a problem for administrative discretion.

The commission and the operators agreed that there is now reasonable compliance with the utilization order, and Elton M. Hyder, an assistant attorney-general, declared the issues are now moot and that a trial would be unjustified, "no matter how interesting a decision might be to the oil industry or the legal profession."

Now Free to Act

Settlement of the Seeligson case leaves the commission free to act where it feels that operators have not diligently attempted to conserve casing-head gas. At the same time, the outcome of the case fails to show what is considered legally to be a reasonable order, and thus future similar actions by the commission could be contested on these grounds.

Prior to the Seeligson case, operators in 14 fields had appeared at hearings at which the commission had ordered them to show cause why the fields should not be closed because of gas flaring.

A check of commission data last week showed that at least seven of these fields are now utilizing casing-head gas in projects constructed while the case was pending. The status of the other seven fields is less certain.

Fields and commission information on gas-utilization projects follow:

Heyser, Calhoun and Victoria counties—compression plant using 35,000,000 cu. ft. daily to be completed in June. Humble Oil & Refining Co. to be operator.

Tom O'Connor, Refugio County—extraction and compression plant completed in December, using 24,300,000 cu. ft. daily. Humble and Quintana Petroleum Co. operators.

West Ranch, Jackson County—Magnolia Petroleum Co. plant completed last June, using 26,000,000 cu. ft. daily.

Anahuac, Chambers County—Humble plant completed last August, using 35,000,000 cu. ft. daily.

Conroe, Montgomery County—Projects planned to take 10,700,000 cu. ft. daily for compression and gas lift.

Webster, Harris County — Humble plant completed March 1947 using 25,000,000 cu. ft. daily.

North Withers and Magnet Withers, Wharton County—Facilities reported still in planning stage.

Agua Dulce, Nueces County—Puenticitas Oil Co. operator of plant of 13,500,000 cu. ft. daily capacity, partially completed January 1948.

North Cowden, Ector County—Cities Service Oil Co. operator of plant completed February 1948 to take 10,000,000 cu. ft. daily, residue going to carbon-black manufacture and transmission lines. Stanolind Oil & Gas Co. planning repressuring plant to be completed January 1950.

Goldsmith, Ector County—Phillips Petroleum Co. plant to be completed July 1948 using 45,000,000 cu. ft. daily.

McElroy, Crane County—Phillips planning plant to take 10,000,000 cu. ft. Gulf Oil Corp. experimenting with returning sour gas to reservoir.

Slaughter, Cochran, Hockley, and Terry counties—Plant taking 57,000,000 cu. ft. daily to be completed December 1948 by Stanolind and others.

Old Ocean, Brazoria and Matagorda counties—Abercrombie Oil Co. and Magnolia plant now taking gas of previously unconnected wells.

KMA, Wichita County—Phillips plant completed November 1947. Plant to take about half of approximately 14,000,000 cu. ft. reported being flared by all operators.

East's Tight Products Situation to Remain

WASHINGTON.—Gasoline consumers east of the Rockies were warned this week that supplies will be tight this spring and summer, particularly in the Middle West, but were given the consoling assurance that next winter will probably be the last really critical period.

However, it was declared by OGD Director Max W. Ball in a 60-page report on the oil situation, it is unlikely that petroleum products will again be abundant and cheap for all uses for 3 or 4 and more likely 5 years.

Ball's report traced the developments which led to this winter's fuel oil shortage and, because of the changes in yield necessary to step up the production of heating fuels, the expected gasoline shortage. Basically, the difficulty has been that lack of steel has made it impossible for the oil industry to keep abreast of the unprecedented and unexpected increase in demand that has taken place since the end of the war, manifested by a peacetime demand in 1947 about 10 per cent above the peak wartime demand in 1945.

Looking ahead, Ball said that existing refineries are now operating close to rated capacities, with plant expansion and essential additions to transportation facilities depending upon the supply of steel.

As a result of pushing up the yield of fuel oil during the winter, local shortages may be expected in many communities, particularly in the Middle West where enlarged demands for agricultural purposes are anticipated, and hardships will be averted only by the same cooperation of consumers that was asked in the case of fuel oil so that available supplies may be spread out.

All-Out Industry Effort to Meet Demand Shown in Annual Reports

ANNUAL financial reports released this week and last by oil companies, both large and small, reflect the all-out effort made by the industry during 1947 to meet the unprecedented and unexpected record demand for petroleum products.

Capital expenditures during 1947 of a group of representative companies showed an increase of more than 50 per cent over 1946, with indications that they will be even greater in 1948 if materials and equipment are available.

Production in practically all instances was at an all-time high and was reflected in record runs to stills throughout the refining industry. Records fell in all phases of the industry as stepped-up exploratory and drilling campaigns boosted the net reserves well above those of 1946.

Pointed out in the reports was the fact that these new drilling, production, and refining records were set in spite of continuing shortages of materials and continued rising costs.

Limited by Shortages

That the records would have been higher was shown in company statements that new construction and development was limited by these shortages.

The companies also called attention to the comparatively low prices of petroleum products, citing the fact that oil now is being sold at a much lower figure than that required to replace the reserves being drawn upon and the fact that the index of products prices is far below the index for all commodities.

Following are brief summaries of operating data taken from reports of a group of representative companies.

Shell Union Oil Corp. made capital expenditures of $138,431,000 during 1947, more than double the $65,542,000 spent in 1946. Disposition of funds included: acquisition and development of oil lands and leases, $63,748,000; refineries and plants, $48,326,000; storage and transportation, $6,733,000; and marketing and other facilities, $19,624,000. Refinery runs reached an all-time high. Net production during 1947 totaled 71,356,000 bbl. against 65,224,000 bbl. in 1946.

Continental Oil Co. capital expenditures in 1947 totaled $45,604,741, compared with $32,270,017 in 1946. Total outlay on producing properties, including drilling and geological and geophysical costs, was $36,918,651, and resulted in a net increase in the company's underground reserves. Production gained from 96,242 bbl. daily in January to 110,469 bbl. daily in December. Year's production was highest in company history.

Ohio Oil Co. capital expenditures increased to $26,791,000 in 1947 from $14,014,000 in 1946. High rate expected to be maintained in 1948. Net production totaled 33,049,523 bbl., an increase of about 1,500,000 bbl. over 1946. Refinery output set a new record, gaining 15 per cent over 1946.

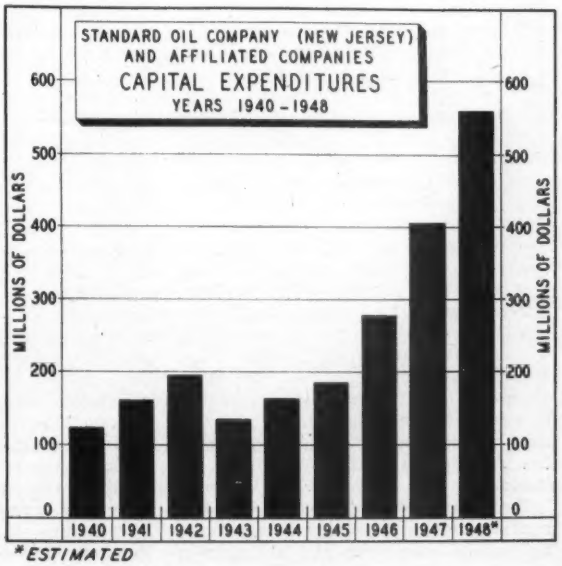
The Texas Co. plans total capital expenditures approximating $375,000,000 during 1948 and 1949 for exploration development and acquisition of producing properties, new and expanded refineries, pipe lines, and marketing facilities, and for new tank vessels. Exploratory drilling in 1947 was 32 per cent above 1946 and new discoveries brought the company's reserves to the highest peak in the company's history.

Skelly Oil Co. during 1947 made capital expenditures of $24,328,685, against $16,763,606 the year before. The company completed 295 wells, against 228 a year earlier, raised crude-oil condensate production from a daily average of 37,260 to 48,848 bbl., and saw its reserves of oil, gas and condensate reach a new record.

Lion Oil Co.'s December 1947 production represented an increase of 42 per cent over the same month a year earlier, and fourth quarter runs to stills, averaging 20,827 bbl. daily, represented a 29 per cent increase over the same period in 1946. A large net increase in reserves also was reported by Lion.

Sunray Oil Corp. had a net production during 1947 of 12,435,253 bbl. compared with 9,491,460 bbl. in 1946. Refinery runs amounted to 4,908,789 bbl., against 3,489,925 bbl. in 1946. Capital expenditures amounted to $14,000,000.

Standard Oil Co. (Ind.) and subsidiaries made capital expenditures of $220,000,000 in 1947, against $159,000,000 in 1946. Crude production averaged 197,000 bbl. daily in 1947, against 177,000 in 1946, and the company expects to reach 220,000 in 1948. Runs to stills in 1947 averaged 370,000 bbl. daily, against 341,000 bbl. daily in 1946. The company expects to step up crude runs to an average of 430,000 bbl. daily in 1948. Capital expenditures in 1948 are expected to be about the same as in 1947, with a drop in 1949.



Illustrating the upward trend in capital expenditures of the oil industry is this graph published by Standard Oil Co. (N. J.), which, with its affiliates, plans expenditures totaling $560,000,000 in 1948. Expenditures totaled $440,000,000 in 1947 and during the 1940-46 period averaged about $178,000,000 annually

Truman Withdraws Nomination of Behling

WASHINGTON. — President Truman last week withdrew his nomination of Burton N. Behling as a member of the Federal Power Commission. No explanation of the action was given by the White House.

Behling is director of the natural-gas investigation and directed the writing of the staff reports over which the commission split so badly that it has never been able to formulate an official report to Congress.

The nomination which would make Behling a member of the commission has been pending before the Senate for many weeks, with indications that no action would be taken at this session on any but the most necessary of President Truman's appointments to policy-making posts.

Had his nomination been confirmed, it would have given the Smith-Wimberly combination majority power to send a report to Congress with official FPC recommendations for changes in the act.

Halt in Steel Exports for Tapline Expected; More Tankers Planned

by Bertram F. Linz

WASHINGTON.—A decision to cut off the export of steel for the Trans-Arabian pipe line and initiate a new tanker-construction program may be announced this week by the Government, as a result of a thorough study of the international situation in its relation to Middle East oil production now being made by the Joint Chiefs of Staff.

Administration officials who, last fall, threw their full weight behind the plan to lay a line to carry Saudi Arabian oil to the Mediterranean were disclosed last week to be reconsidering their position in the light of recent world developments.

Testifying before the Senate small business subcommittee March 17, Defense Secretary James V. Forrestal said he had turned the matter over to the "appropriate military authorities" for study, and expected to have their decision by the end of the week. With Secretary of Commerce W. Averell Harriman, he is to appear again before the subcommittee this week to disclose the decision of his expert advisers.

Military View Sought

Forrestal explained that his decision last fall to support the pipe line was based on the immediate scarcity of oil world-wide, the large reserves available in the Middle East, the European Recovery Program and the importance therein of Middle East oil and "purely military considerations of the need for large supplies of oil if we should ever face another war."

But "in the light of the events of the last several weeks," he said, it has become apparent that the matter of steel for the pipe line must be reviewed, and the Joint Chiefs of Staff have been asked to decide whether they would prefer to have the steel used for the construction of tankers or in the pipe line.

At the same time, both Forrestal and Harriman pointed out the Government's authority over steel does not extend to allocation for domestic use, and there is no assurance that the steel intended for pipe line would be diverted to tanker construction. They agreed with subcommittee chairman Kenneth S. Wherry of Nebraska, however, that the keeping of steel in this country could help to alleviate the shortage of that metal in the oil industry.

Harriman, who appeared at the hearing with a prepared statement defending the export allocations, quickly sided with Forrestal's statement that the whole question should be reviewed, and assured the subcommittee that no definite allocation would be made for the second quarter until consultations had been had with Defense and State Department officials. He said if no further steel is allowed for the pipe line that already shipped would not be wasted but could be used to carry oil from the producing fields to tidewater on the Persian Gulf.

Drops Synthetics Plan

Forrestal also appeared to be backing down from the strong support he recently gave Interior Secretary J. A. Krug's plan for high-speed development of a synthetic-fuels industry, telling the subcommittee that it would take 5 years and a billion dollars or more to develop a synthetic production of 100,000 bbl. daily, a mere teaspoonful of the more than 5,000,000 bbl. a day which we now are consuming.

At the opening of the hearing, Wherry declared that recent events have strongly supported the subcommittee's position that steel should not be sent to build the Trans-Arabian pipe line, for which, he said, 20,000 tons of pipe alone were exported in the last quarter of 1947, over 33,000 tons authorized for the current quarter and 55,000 tons suggested for the second quarter.

He asked James Terry Duce, vice president of Arabian-American Oil Co., about the possibilities of securing concessions to carry the line through Syria or Palestine, and was told that the application for concession has not yet been approved by Syria but it is hoped that it will be within a month, and an admission that, while it has rights through Palestine, the company would not attempt to put the line through there under present circumstances.

Taking cognizance of a story in a New York paper that Aramco had paid money to Saudi Arabian representatives in this country, Wherry showed Duce a check he had subpoenaed from a bank, made out to cash in a sum in excess of $3,500, and asked what it was for.

Duce explained the company purchased automobiles and other supplies for the embassy, charging them against the king's royalties, and asserted Aramco had full authority in advance for all such activities. He promised to list all the checks and payments made and submit them to the subcommittee, together with the authorizations.

Two Companies Plan to Drill Off Texas Coast

HOUSTON.—Steps looking to the first drilling operations since before the war in the open water off the Texas Gulf Coast have been taken by two companies.

The Texas Co.'s South Texas division, producing department, Houston, filed application with the Army Engineers office in Galveston requesting a blanket Department of the Army permit for all structures and work necessary to oil development in the Gulf of Mexico about 3 miles off shore and 6 miles southwest from High Island, Galveston County.

The area covered in The Texas Co. application consisted of 4,640 acres in State Tracts 58 (NW ¼), 135, 136, 137, 139, and 140. The proposed work would be carried on in water varying from 19 to 35 ft. in depth. The drilling structure foundation would consist of pile and caisson-type construction with cable braces over an area of about 90 by 290 ft.

Humble Oil & Refining Co. filed application with the Army Engineers office requesting a permit to drive three 24-in. steel test piles 200 ft. apart in the Gulf of Mexico about 8,000 ft. northeast from the center line of the Freeport entrance channel and about 7 miles east of the harbor jetties at Freeport. The piling would be driven to a top elevation of 10 ft. above mean low water, and a steel and timber platform 20 ft. square would be erected on top of each pile to permit coring operations.

Davidson Says Elk Hills Reserve to Be Enlarged

WASHINGTON.—The Interior Department last week revealed it is planning to withdraw from leasing those public lands surrounding the Elk Hills Naval Oil Reserve so that the reserve might be enlarged and the Navy test those areas.

Appearing before the House armed services oil subcommittee, Assistant Secretary of Interior Davidson said he had decided on the basis of January hearings in Los Angeles that the public interest required such a move.

Davidson said the Navy had agreed that in the event exploration showed the Elk Hills structure did not extend into any of the sections which are to be added, they will be returned to Interior for private development under the leasing laws, while if other pools which do not drain Elk Hills are found in sections into which the Elk Hills structure extends, the Navy will make leases for development of such pools.

this week

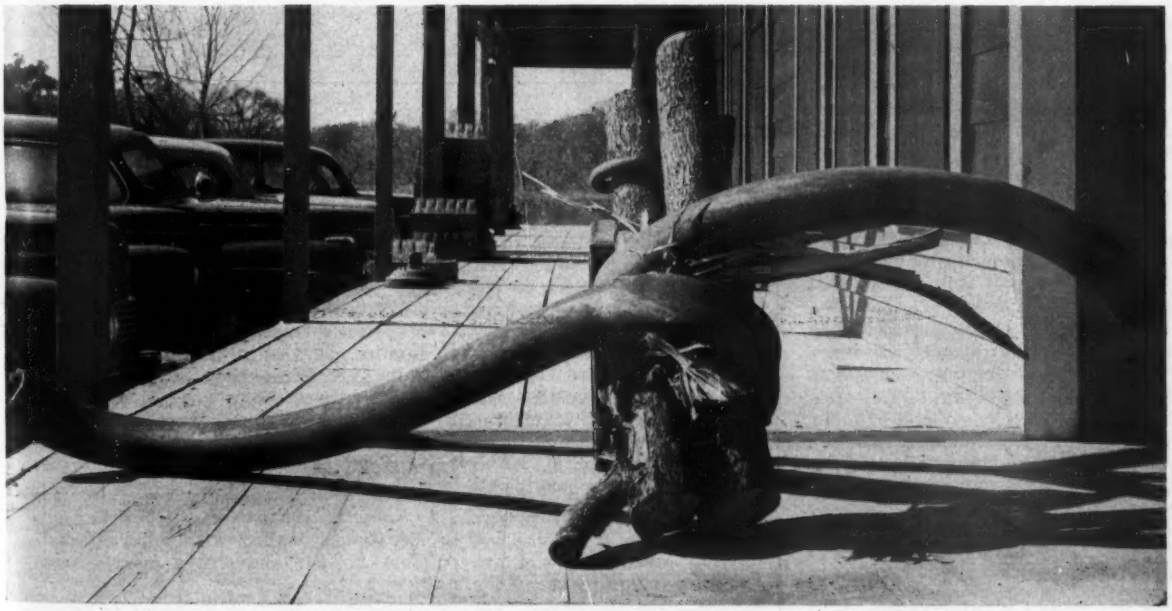
INTERNATIONAL—Venezuela announces new oil policy whereby government will receive 50 per cent of company profits. . . . Difference between taxes and other charges and company profits to be made up by special assessment. . . . ¶South African company gets rights to hydrocarbon-synthesis process of Hydrocarbon Research, Inc., to build $56,000,000 synthesis plant. . . . ¶Decision to cut off exports of steel for trans-Arabian pipe line expected in Washington soon. . . . Military leaders now reviewing international situation as it affects Tapline. . . . Steel may be used for tanker-construction program. . . . ¶Mexican officials confer with State Department on new basis for return of American oil interests to Mexico. . . . ¶State Department warns Latin-American nations with oil potential to develop own resources. . . . Says not depend on United States for supplies. . . .

PIPE LINE—Humble Pipe Line Co. awards contract for construction of three 12-in. loops in Texas. . . . Contract for 24-in. loop in Central Illinois let by Natural Gas Pipeline Co. of America. . . . Sunray Oil Corp. completing last 10 miles of 6-in. Allen-Beckett, Okla., line. . . .

INDUSTRY—Annual financial reports show capital expenditures 50 per cent greater in 1947 than preceding year. . . . Indicate 1948 expenditures to be even greater if materials available. . . . ¶First open-water drilling operations off Texas Gulf Coast since before the war seen in The Texas Co.'s application for permit to conduct work near High Island. . . . ¶Products to be tight through this summer and next winter, OGD Director Max Ball predicts. . . . Oil not to be abundant and cheap for probably 5 years, Ball says. . . . ¶Committee of 33 named as advisory group on oil-industry voluntary agreement. . . . Group to meet April 1. . . .

GOVERNMENT—Senate judiciary subcommittee approves tidelands legislation two-to-one after 4 weeks of hearings. . . . Senator Donnell of Missouri protests strongly. . . . Continued opposition by Donnell is expected when the bill reaches the full committee and the floor of the Senate. . . . ¶Oil industry awaits congressional decisions regarding military moves affecting oil-supply situation after July 1. . . . ¶Discovery of forging of export licenses brings call for investigation by Senate small business subcommittee. . . .

TRENDS—Stocks in four major products show little change as slight gains in gasoline and heavy fuel oil offset continued drops in distillates and kerosine. . . . Consumption reaching end-of-March balance, with reverse in stocks trend due soon. . . . ¶Kerosine output drops as refiners begin concentrating on gasoline production. . . . Kerosine yield down to 6 3/4 per cent. . . . Distillate yield holding at about 20 per cent. . . . ¶Runs to stills back to normal at 5,407,000 bbl. daily following low runs of previous weeks. . . . ¶Crude production drops again as result of bad weather. . . . Kansas and Oklahoma show decided drops, while California output reaches 946,700 bbl. daily, new state record. . . .



"Unusual" things are always happening in the oil industry, and this freak pipe twist-around is one of the occurrences in that category. It happened in the natural gas-gasoline-cycling part of the business, which is featured in this issue (The Journal's annual "Natural Gasoline" number). The pipe was part of a 4-in. o.d. high-carbon steel line of 0.455-in. wall thickness, which was carrying gas-condensate at 2,900-3,000 psi. in a South Texas distillate field. It parted at the left end and the force was enough to loop it around a nearby tree like a necktie

Subcommittee Approves Tidelands Bill, Donnell to Continue Fight

WASHINGTON.—Hearings on the tidelands legislation dragged to a weary close last week over the protests of Sen. Forrest C. Donnell of Missouri.

A few minutes after the last witness left the stand, the Senate judiciary subcommittee voted two-to-one to send the measure along to the full committee, with Donnell still protesting the affirmative votes of Sens. E. H. Moore of Oklahoma, chairman, and Pat McCarran of Nevada.

Donnell's two big fights are yet to be made, the first in committee, where he will attack the cutting short of the hearings by Moore, and the second on the floor of the Senate, when the bill gets there.

Displaying for some time signs of growing irritation over Donnell's protraction to 4 weeks of hearings designed to be cleaned up in 2 (McCarran at one point commented it had all the appearance of a filibuster), Moore broke loose March 18 and announced the hearings would end that day. Donnell protested vigorously, but after a heated interchange Moore's order stood.

Reporter Questioned

In the last hours of the hearings, Donnell put the spotlight on the St. Louis Post-Dispatch, which has been conducting a 3-year campaign on the tiedlands issue. He called to the stand Edward A. Harris, one of the paper's Washington correspondents, who won a Pulitzer prize for a series of tidelands stories in 1945, to testify that he had been told oil interests had agreed to pay a portion of the salary of William W. Clary, special assistant attorney general of California, who helped draft the tidelands quitclaim bill which President Truman vetoed. Harris named as his informant Robert W. Kenny, California attorney general in 1945.

Donnell also called for testimony from some of the persons who have filed applications for federal leases on the tidelands, including T. S. Hogan, Los Angeles attorney and oilman, who vigorously denounced the bill and was equally denunciatory of the administration's "management" bill, which provides for the leasing of such off-shore oil lands as may not be set aside by the President as naval oil reserves or withdrawn because of navigation or other needs.

Hogan denominated the measure "strictly a monopoly bill," which he said would violate and nullify the Federal Leasing Act. He declared also it would eliminate from any participation in the development of the tidelands independent and small operators with assets of less than $1,000,000.

At the Interior Department, meanwhile, officials said again they cannot accept applications for oil and gas leases on either the tidelands or Continental Shelf until Congress has acted.

A formal statement was issued by the department in an effort to head off a new flood of applications reportedly in the making by interests anxious to get leases the moment the gate is opened by the failure of the quitclaim legislation.

More than 1,000 applications for leases, accompanied by fee and advance rental payments of nearly $500,000, were filed with the department several years ago when it became apparent the Government was going to test California's title, and were held on file for nearly 2 years, until the Department of Justice last year ruled the lands were not subject to lease under the mineral leasing laws.

Decision Witheld On Alford Well Allowable

AUSTIN.—Evidence in support of a continued 500-bbl. daily allowable for Slick-Urschel Oil Co. 1 Alford, discovery well of the new Benedum field in Upton County, was taken at a Texas Railroad Commission hearing here March 18.

Principal witness was Gilbert C. Thompson, Midland, Slick-Urschel engineer. A decision on the allowable will be given later by the commission. The company also submitted a proposed set of field rules at the hearing, but commission officials indicated a decision on this may be withheld pending more data on the reservoir.

Thompson said shut-in bottomhole pressure of the well was 5,227 psi. December 16 and 5,225 psi. February 1. During this period, approximately 23,000 bbl. were produced. He said experiments had been conducted with various chokes up to ¼ in., and that the tests indicated an increase in gas-oil ratios for the smaller rates of flow.

Three rigs now running in the field are using gas from the well and three other operators have requested gas for drilling. The total amount of gas to be used for the six rigs, he said, of 1,728,000 cu. ft. daily is about the amount of gas being produced at the present rate of 500 bbl. daily. Experience in other Ellenburger fields indicates, he said, that this field will also provide an effective water drive. Besides the 500 bbl. daily allowable, the company asked a 4,000:1 gross gas-oil ratio.

The field rules proposed 1,866-660 ft., staggered 80-acre spacing which, Thompson said, was designed to facilitate later 40-acre development if found desirable. Proration unit would be 80 acres with a 40-acre tolerance. Allowables would be on the basis of 75 per cent acreage and 25 per cent number of wells.

NEXT WEEK . . .

The Annual Refining Number

Next week's issue of The Journal will be the Annual Refining Number, which has been designed as a practical reference work on petroleum refining and petrochemistry. The special material will open with a 48-page 3-color section which will feature, page by page, the most up-to-date descriptions of leading refining processes. Each process is presented by both an illustrative flow diagram and an over-all discussion describing latest developments. These were prepared cooperatively by The Journal's refinery-engineering staff and the leading process-design and petroleum-refining companies in the country.

The issue will also contain a number of articles on refining and petrochemistry especially prepared by some of the foremost technicians in the industry. A feature will be discussions dealing with practical cost-saving procedures that are possible through preventive maintenance, plant revisions, and remodeling.

Included also will be The Journal's annual survey of individual refineries and a report on construction projects under way and those planned for the future.

Latin Nations Warned to Produce Own Oil, Told U. S. Faces Pinch

WASHINGTON. — Western Hemisphere countries with oil resources of their own may be forced to develop them to keep their own economies going and can no longer look with assurance to the United States for petroleum supplies, it was intimated last week by the State Department.

The department disclosed that on March 8 it had submitted a memorandum to the Pan-American Union, calling upon all American republics with oil resources to open their doors to the "world petroleum industry," which it declared was not only the best but the most practicable manner of developing large potential oil areas.

The memorandum was prepared by Paul Daniels, chief of the division of American Republic Affairs and United States representative to the Inter-American Economic and Social Council, operating under the auspices of the Pan-American Union.

No Surplus in U. S.

Daniels pointed out that the United States, which receives repeated urgent requests from foreign countries for assistance in obtaining oil supplies necessary to meet their essential requirements, is itself short of oil. World demand, he said, is expected to increase by 1,500,000 bbl. daily within the next 3 years, and if this is to be provided "there must be not only an increase in that amount of crude-oil production but also increased refining capacity, pipe lines, and tankers.

"Such a program," he added, "will necessitate the discovery and development of new reserves and the construction of additional refining and transportation facilities. Anyone familiar with the operations of the industry knows that this rate of growth would be staggering even if all the steel and other necessary materiel were readily available. With the critical shortage of materiel, particularly steel products, the task becomes immeasurably more difficult."

The United States, Daniels said, recognizes the importance to all countries of meeting their essential requirements for oil products in order to sustain their economies. "At the same time," he added, "there is a limit to the assistance which can be given by exporting petroleum products from the United States," which now is on an importing basis.

"The United States, therefore," he warned, "cannot be expected to continue long in the future to supply any substantial part of the requirements of other countries except for lubricating oils and other specialty products.

Development Needed

"The economies of most countries have become dependent in large part upon petroleum," the memorandum continued. "As petroleum is expected to be in short supply for the next few years at least, it would be desirable for any country wishing to insure itself against an insufficiency of petroleum to examine its own area to determine the possibilities for the development of indigenous petroleum resources. Many countries in the Western Hemisphere are believed to possess large unexplored areas where the possibilties are good for the development of important petroleum reserves. Intensive exploration and development operations in these areas might well produce more than enough oil for local consumption, leaving a surplus for export. The critical worldwide shortage of petroleum supplies is a factor to be taken into account by all countries in deciding the extent and rate at which their oil reserves are to be developed."

Daniels emphasized that the development of the resources of any country with large potential oil areas requires vast amounts of capital, efficient management, and large numbers of highly trained technical and scientific personnel.

"It is doubtful," he said, "whether any one company or entity, no matter how large, could be expected to develop such resources successfully and efficiently. What is required is access to adequate and large volumes of risk capital, all of which would be available fully and freely by calling upon the world petroleum industry.

"A country would derive many benefits from the development of its petroleum resources. Such development would produce oil required by its economy, including fuel for its expanding industrialization, and permit the rapid expansion of its economy, resulting in greater industrialization, higher standards of living, a saving in foreign exchange, and an opportunity to greatly enhance its exchange position by exporting petroleum."

Texas Allowable Remains High; Drop Expected Following MER Hearings

AUSTIN.—Texas' new crude-oil allowable order provides a continued high level of production for April, but some reduction is anticipated in succeeding months.

The Railroad Commission's order for April sets a net allowable of 2,601,760 bbl. daily. The commission estimated underproduction at the somewhat lower than usual figure of 5.8 per cent, or 150,902 bbl. daily. This leaves estimated April production at 2,450,858 bbl. daily.

The commission has scheduled a series of hearings next month at which engineering evidence will be taken on new maximum efficient rates of production for Texas fields. Allowables generally have permitted production up to the full limit of the MERs determined a year ago, but the revisions next month are expected to result in some lower total for the state as a whole.

Jack K. Baumel, the commission's chief engineer, told the statewide market demand hearing here March 16 that the new MERs will be available between May 1 and 15, and commission members said changes will be made as soon as they are determined.

Purchasers' nominations for April crude oil totaled 2,833,383 bbl. daily, an increase of about 46,000 bbl. daily over March. Most of the increase was in West Texas where 30,843 bbl. daily additional was asked. Bureau of Mines estimate of April crude-oil demand in Texas was 2,450,000 bbl. daily.

East Texas field, the only field in the state subject to shutdown days, was placed on a 21-day schedule for the 30-day month of April. The field is on 22 producing days in March. The April schedule gives a net allowable of 318,818 bbl. daily, down 4,236 bbl. daily from the net allowable as of March 13.

Col. E. O. Thompson, commission chairman, reported that average bottom-hole pressure in East Texas field showed a decline of 2.96 psi. from 1,014.41 to 1,011.45 psi. during February when the field was on a 20-day schedule.

With underproduction throughout the state at 5.8 per cent of the allowable during April, Texas' expected production of 2,450,058 bbl. will exceed the Bureau of Mines forecast by 858 bbl. In addition, production of natural gasoline and distillate during April is estimated at 221,399 bbl. daily. Total liquid hydrocarbon output in the nation's major producing area next month is thus expected to be 2,672,257 bbl. daily.

International

WORLD-WIDE OIL DEVELOPMENTS

New Venezuelan Oil Policy to Take 50 Per Cent of Company Profits

OIL companies operating in Venezuela have been informed that in the future the Government will insist on taking 50 per cent of their declared profits and will make special assessments of such portions of this percentage as are not already being collected in taxes.

Formal anouncement of this policy is expected to be made in Caracas shortly, and steps will be taken to enact it into law during the coming year. The proposal has been discussed with the companies for several months and decision to proceed was served on them at a meeting in January by Dr. Juan P. Perez A., Minister of Development, and Dr. Jose Martorano B., chief of the Venezuelan Petroleum Bureau.

In a statement to The Oil and Gas Journal this week, Martorano explained the policy as follows:

"When the present Hydrocarbons Law was initiated by Congress, the political party now in power was then in the opposition. It maintained that the law did not provide for future eventualities in which the increase in price or volume of oil produced might alter the relative participation of the Government and the companies in the profits derived from the oil industry. That principle was the basic reason for the reforms instituted by the said 1943 Hydrocarbons Law.

No Changes in Taxes

"The increases in prices and production which have taken place during the past years have shown clearly the unforeseen inequalities in the share of the profits obtained by the companies and the nation, respectively. The Revolutionary Government proceded, at the end of 1945, to assess an additional income tax so that the nation might obtain what was equitably due it. To this end the Government submitted the following year to the National Assembly the new income tax law which that body accepted and approved.

"Now that some time has elapsed it has been established that the increase sought by the income tax was based on facts and figures which did not adapt themselves to the reality of the situation, and therefore the objective pursued was not attained. The importance of needed adjustment in 1947 is more apparent in view of the situation revealed by data at hand. A revision of the income tax does not seem advisable; the same possibility of the rates not conforming to future changes in the situation will prevail. Because of this possibility, beginning with June 1947, the Government initiated a series of conferences with the two oil companies whose share of the profits exceeded the 50-50 participation sought by the Government, so that they would agree voluntarily to pay the balance required to equalize the nation's share in those profits.

"To attain this objective, the profits of each of the oil companies will be determined from the profits and losses shown in the annual report issued to the stockholders and which auditing firms of the said companies have certified as correct after examining and checking their books.

"The amount of money which each company shall pay the Government for the period in which the profits were made will be determined by taking into consideration the sum total of the exploitation tax, the income tax, and all other taxes which directly or indirectly, are paid by the company and charged to the profit and loss account. Of the amount paid for import and consular duties as well as from related taxes the total levied upon items which belong in the category of capital assets shall be exempted.

"If the sum total of these taxes fails to equal 50 per cent of the net profits declared by the company, the excess of the latter over the former shall be equally divided between the nation and the company. During the current year a thorough study on this matter will be made in order to enact this principle into law."

At the January conference, attended by representatives of all principal oil companies operating in Venezuela, the officials also declared that the Government is very much interested in increasing the utilization of natural gas produced with petroleum and that it expects the operators to take the necessary steps to bring about this objective by installing extraction or repressuring plants or returning the excess gas to the formation for future use.

Synthesis Plant for South Africa Planned

Anglo Transvaal Consolidated & Investment Co., Ltd., through an agreement with Hydrocarbon Research, Inc., has obtained South African rights to the latter's process for hydrocarbon synthesis.

Anglo Transvaal, in conjunction with South African Torbanite Mining & Refining Co., Ltd., plans construction of a $56,000,000 plant at Vereening for the synthesis of 20,000,000 gal. of high-grade motor fuel a year.

Foster Wheeler Corp., together with Hydrocarbon Research, Inc., is engaged now in making a complete engineering and economic study of the entire project.

Imperial to Sell Stock in International Petroleum

Imperial Oil, Ltd., is planning to sell its common-stock holdings in International Petroleum Co., Ltd., to Imperial shareholders on a pro rata basis, according to Henry H. Hewetson, Imperial president.

Standard Oil Co. (N. J.), 70 per cent owner of Imperial, has indicated that it is prepared to purchase its portion of International shares, which means that International will change from indirect to direct affiliation with Jersey Standard.

Hewetson said the sale is being contemplated to obtain sufficient funds for exploratory and development work in western Canada.

Mexico Making New Proposals For Return of Foreign Capital

International

by Warren W. Burns

THE possibility that Mexico may again become one of the world's most significant oil-producing countries, and in the relatively near future, appears to be increasingly certain. But whether major foreign oil companies, independent foreign oil operators, or the Mexican government will handle the projected expansion program remains uncertain.

The disclosures this week that the U. S. State Department and officials of Petroleos Mexicanos, the Mexican Government oil agency, with the aid of U. S. Ambassador Thurston were discussing a Pemex proposal for a basis on which foreign oil interests might again operate in Mexico has shown how anxious the Mexicans are to increase indigenous crude-oil production.

Anxious as they are, however, the Mexicans do not figure the only way to increase their production is by creating a favorable climate for foreign operators. One high ranking oil company official told The Oil and Gas Journal this week that unless Pemex and United States oil companies (and presumably other foreign interests, notably the Royal Dutch Shell) can arrive at more equitable terms than Pemex is currently offering, there is a good chance that the Mexican Government might turn to the U. S. Government for direct financial aid.

May Seek Loan

In essence, Mexico might say that as the United States oil companies decline to accept the Pemex terms, and in view of the anxiety on the part of the U. S. Army and Navy to see Mexican production increased, the United States should make a long-term loan to Mexico so that Mexico might finance its own oil program.

It appears certain that such a proposal would have the backing of the U. S. Army and Navy as both are on record as to the importance of increasing Mexican production.

Many United States oil men have stated that unless the current Pemex conditions for reentering Mexico are fundamentally changed there is no chance of any large operator accepting the terms. When Pemex director Antonio J. Bermudez was in New York several weeks ago he gave the impression in an informal conversation that possibly his government would be more favorably inclined to see independent rather than so-called major companies interests develop the petroleum resources of Mexico.

One of the greatest objections to the current Pemex proposal on part of the foreign interests is that it may be illegal and most U. S. oil men have stated that they will do nothing to help circumvent Mexican law. Other major objections concern drilling sites and management. Pemex would like to designate the areas to be explored and the sites to be drilled, as well as having the right to supervise management and approve budgets. Major oil company spokesmen say they will never agree to these terms, for if they are to supply the "know how," the foreign oil companies would insist on acting on their own exploratory advice and method of operation.

Moreover, many foreign oil companies probably will insist on a more equitable distribution of profits. The Pemex proposal states that if oil is found, exploratory and development expenditures would be recovered from up to 80 per cent of the value of the sale of the oil after deducting operating expenses and taxes. Thus after a company had recovered its investment the company would receive from 10 per cent to 20 per cent of the value of the sale of the oil after deducting operating expenses and taxes.

The question of government ownership of subsoil rights is not questioned by most of the companies which evidence interest in Mexican operations. Moreover, the oil companies which had their property expropriated 10 years ago agree that is history and are willing to start again on a clean slate. However, the next time they would insist on reasonable assurance that their operations would not be expropriated and that the U. S. Government take a more active interest in the oil operations of its nationals in Mexico.

Shipment of Oil Equipment to Romania Held Up Following Acts Against Shell

FOLLOWING closely on the announcement that the Communist-dominated Romanian Government has forceably dissolved the Royal Dutch-Shell subsidiary in Romania, Astra Romana Societe Anonyme, it was learned that the U. S. State Department is impeding the shipment of approximately $11,000,000 worth of oil industry equipment to Romania.

Last summer, the State Department protested Russia's failure to pay for 7,000 tons of oil equipment removed from Romano-Americana, subsidiary of Standard Oil Co. (N. J.). To date the Russians have failed to answer this protest, aside from stating that Soviet actions are in accordance with the Potsdam agreements.

Late last year, the Romanian Government appointed a state administrator for the Shell company. However, Astra Romana officials found it impossible to operate under the administrator's demands and this past week stated: "As a result of the many acts of interference by the supervisory administrator," it was necessary to dissolve the company.

To date, no state administrator has been appointed for the Jersey Standard affiliate, but informed sources are daily expecting that the Romanian Communist officials will find some excuse to dissolve this company also.

Meanwhile, the Romanian Commission of Economic Renovation and Monetary Stabilization is reported to have decided upon the appointment of a new state administrator for Astra Romana and to have stated:

"The old directors (of Astra Romana) abandoned their functions because they were afraid of their responsibilities towards the state authorities. The old managers sabotaged the renovation of the national economy and had placed oil production in a desperate situation."

The British Government announced that it reserved all rights to intervene on behalf of the British majority shareholders of Astra Romana. A note to the Romanian Government, published in London, said the British majority beneficial shareholders must henceforth be regarded as being endowed "with the powers and rights formerly enjoyed by Astra Romana." Shell owns about 72 per cent of Astra Romana.

The British note, moreover, alleged that the "supervisory administrator has interfered in the affairs of the company in a manner which is detrimental to the shareholders' interests and incompatible with the corporate functioning of the company."

Major Developments, 1948 Plans Discussed by Creole Engineers

by Kenneth B. Barnes

DEVELOPMENT in Venezuela of new Eocene and Cretaceous reserves, a new method of searching for oil, forthcoming 1948 expenditures of $42,000,000 for materials and supplies, planning for new conservation projects on natural gas, natural gasoline, and pressure maintenance operations —these topics and other engineering efforts were coupled with cost saving studies in a recently completed conference by Creole Petroleum Corp. at Caracas.

The conference had an international flavor as the group of 125 drilling, production, and plant engineers, geophysicists and geologists, besides those from Creole's eastern and western Venezuela's divisions, included representatives from Humble Oil & Refining Co., Standard Oil Development Co., Carter Oil Co., and Imperial Oil Co., Ltd. All of these concerns, including Creole, are affiliated with Standard Oil Co. (N.J.)

Several meetings of the Creole engineering session were held in the Colegio de los Ingerieros (see cut) which is located in the Los Caobos section of Caracas. Some talks were given in the Edificio Republica building where Creole's research laboratories are concentrated, while other assemblies were in Creole's headquarters building (see cut, next page).

New Exploration Method

One high-point paper gave a description of a completely new method of searching for oil. Basis of the new procedure—still in the experimental stage—is based on the existence of earth currents which are caused by the motion of the earth through space.

The so-called earth or "telluric" currents form regular electrical current patterns on the face of the earth, which maintain a fixed position with regard to the sun. No detailed explanation of the origin of these currents has yet been accepted, but they probably are caused by the effect of other terrestial bodies which cause variations in the earth's magnetic field as it moves through space. Creole engineer R. S. Dahlberg explained that the importance of telluric currents to the oil industry is that the regular pattern of these currents is deviated by structural changes in the earth. A rise in the basement rock beneath the earth's surface, for example, will force the currents upward.

International

Since petroleum geophysicists are interested in charting the pattern of geological structures between the earth's surface, efforts are now being made to relate variations in the telluric currents with subsurface geology. The currents can be measured by voltmeters, connected with the ground at selected intervals.

Further development of the new method may offer several advantages to the geophysicist, and he would not be handicapped by the necessity for using bulky and heavy equipment in surveying new areas which often are difficult of access in Venezuela and elsewhere.

Also reported were the prospects of development of new Eocene and Cretaceous reserves in Venezuelan oil fields. M. W. Haas, Creole geologist, pointed out first oil production in western Venezuela from the deeplying Cretaceous formations came in the Maracaibo area in 1944. Improved drilling methods, making it possible to reach depths of more than 10,000 ft., increase the possibilities that Cretaceous reservoirs will be found throughout Venezuela — especially in areas which are already producing oil from higher sand layers.

Gas Conservation Discussed

Projects have been completed or approved in which Creole will spend some $14,000,000 to conserve natural gas on properties produced by the company. S. F. Mauney, natural-gas and gasoline-plant engineer for Creole, stated the company's conservation program will enable it to save gas at a higher rate in its operations in Venezuela than is being saved today in similar operations in the United States—the country now most advanced in this project.

Already Creole has gas conservation plants completed or approved for construction which include those at Jusepin, Mulata, Quiriquire (three plants), West Guara, Cumarebo, and two projects in the Bolivar Coastal Fields. "If the proposed projects can all be carried through, in the near future," Mauney reported, "Creole will have progressed further in a shorter time, and under poorer economic conditions than some of the United States operations, which in certain cases have taken longer than 40 years to reach their present high percentage of gas conservation and utilization." If the original projects of the company are successful, it is planned later to invest large new

The Creole engineering conference was conducted principally in the beautiful Colegio de Ingenieros de Venezuela building (entrance view shown here) which is located in the Los Caobos park area of Caracas. The "Colegio" corresponds in meaning to the "Engineers Club of Venezuela." "Los Caobos" means "The Mahoganies," with the name of the park coming from the large grove of towering mahogany trees which cover the area

amounts which will enable Creole to save practically all of the gas it produces.

Mauney revealed at the present time Creole is making use of some 137,500,000 cu. ft. of gas daily produced in its various fields. Greatest obstacle in the use of further natural gas, he pointed out, is the fact that it is not economically profitable.

One of the plans which Creole has given careful consideration is the transmission of gas to the Caracas area from eastern Venezuelan oil fields. This project would cost about $22,000,000 and would eventually use 165,000,000 cu. ft. daily. The gas would also be provided to the Puerto La Cruz, La Guaira, Maracay, and Valencia areas. The return, however, would be very low on this investment, due primarily to the fact that gas would have to compete in industrial plants with the low-cost fuel oils now being provided to Venezuelan consumers. The interest of the Venezuelan Government in such a project, however, may make the installation of such a gas line possible.

$42,000,000 for Materials

The high costs of operation in Venezuela were emphasized at the meeting. R. D. Moriarty, head of Creole's material department, disclosed that the company must spend approximate $42,000,000 for materials and supplies during 1948. Of this total, he pointed out, some $12,000,000 of orders will be placed in Venezuela and neighboring South American countries.

Not only have material prices gone up since the war but they can be expected to continue upward, Moriarty warned. Export-license control in the United States makes it difficult to secure steel plate, pipe, fittings, and electrical, plumbing, and building supplies. The United States housing program and the plans for shipping large stocks of goods to rehabilitate Europe make the prospect for decreased supplies and higher prices almost certain.

The shipping crisis also was stressed by Moriarty, stating that since the United States has become the manufacturing and supply center for the world it will require more ships to carry goods abroad than there are ships in existence. Nearly all United States ports have great quantities of cargo backed up for lack for shipping space and Creole alone, he said, requires approximately 20 ships monthly from United States ports to keep up the flow of necessary material for its operations.

Creole is now handling the great volume of its imports at its own ports, to care for materials at the Venezuelan end and ease congestion at regular Venezuelan ports of entry. Its Caripito port has been opened up to take 2,000 tons per month. Its La Salina port is now taking 7,000 to 8,000 tons monthly, as compared to 4,000 to 5,000 tons last year. For Creole's new refinery on the Paraguana Peninsula, its Amuay port will be handling 10,000 tons monthly. Such a vast flow of materials to the company in Venezuela presents a tremendous storage problem, but the company is doing everything in its power to keep materials flowing to its operations.

Roads and Construction

Road construction and maintenance costs also were emphasized as a most important phase. S. J. Mathis, of the Creole highway department, said during 1946 alone Creole had spent 20,000,000 bolivars on roads (approximately $6,200,000). Creole highway engineers are analyzing the different costs connected with highway construction. Some of the roads that the company has built in Venezuela cost as much as 100,000 bolivars per kilometer (approximately $52,000 per mile) to build, and efforts will be made to reduce that figure so that the company's highway program need not be reduced in volume.

Need of finding a method of constructing houses rapidly and economically in Creole camps was discussed by another engineer, E. Harris, who reported that the company recently sent one of its technicians to the United States to make a complete survey there on the most recent methods, designs, and cost data on modern types of construction.

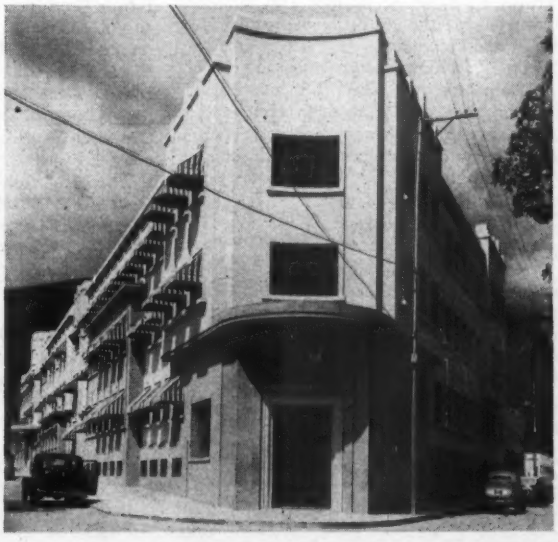
Under Lake Maracaibo, Creole has laid 25,000 tons of gathering lines and crude-oil transmission systems. A research problem on which Creole has worked hard is to avoid the damaging effects of corrosion. Losses from this source have been estimated to amount to 2,000,000 bolivars (approximately $625,000) annually. The world shortage of steel and difficulties in obtaining pipe have made this a particularly serious problem at the present time. Reduction of the corrosion rate would make available several thousand tons of steel each year for other important oil operations, such as casing, tubing, and drill pipe. Condition of the pipe lines in Lake Maracaibo also has an important effect upon the life span of the oil wells there. When the pipe lines become so damaged that the well must be shut in temporarily, in some cases the ultimate recovery of the well is believed to be decreased.

Creole has been conducting experiments at two stations in Lake Maracaibo to determine the results of cathodic electric currents in reducing corrosion. Other laboratories in the United States are also working on this problem for Creole. Various types of paint and plastic materials also have been tested to determine their resistance to corrosion. Dr. J. H. Zauner is working full time on corrosion problems for Creole.

Venezuelan Costs Going Up

A. T. Proudfit, president of Creole, told the group that the production and facilities for putting oil on the market will eventually catch up with the present high world-wide demand and then the price of crude oil can be expected to fall off. Finding costs of oil today are increasing at a greater rate, Proudfit warned, than has the price of products.

The Creole president made it clear to the conference that the company's ability to continue in business in Venezuela during future years would depend upon the reduction of costs. High costs—which can be successfully absorbed now by Creole because of high market prices—will constitute a threat in years to come.



Headquarters building at Caracas, Venezuela, of the world's largest crude-oil producing company. Creole's home office is of triangular shape, with each side being more than a block long. In January of this year Creole pushed its daily crude-oil production in Venezuela to an average of 617,019 bbl. per day compared with its heretofore all-time high of 616,838 bbl. reached in December 1947. Of the January production, 460,746 bbl. came from the Lake Maracaibo area, 150,952 bbl. from eastern Venezuela, and 5,321 bbl. from Cumarebo

WASHINGTON WATCHING

BY BERTRAM F. LINZ

Steel Fight Ahead

WASHINGTON.—The oil industry's estimate that it will require more than 10 per cent of total steel output of the country over the next 18 months will get a thorough going-over and meet a lot of opposition when the Department of Commerce holds its public hearing on the report submitted last week by the NPC committee on petroleum industry steel requirements.

Unfortunately, there are no adequate figures on oil-industry steel consumption in the past against which the committee's estimates can be gaged, but some government officials already have indicated they think the asserted requirements are too high.

At the public hearing, the industry is expected to argue that never before in peacetime has it been faced with the necessity of an expansion of production so large and so quickly as now, and that the estimates represent what is believed to be necessary to achieve the goals that have been laid out.

The earmarking of so large a volume of steel for oil will be bitterly opposed by other steel-consuming industries that will contend it cannot be done without putting a lot of companies out of business and creating a large amount of unemployment.

The estimate for production steel is based upon the number of wells which it has been determined must be drilled this year and next and computed on experience as to the steel required per well. The estimate for refineries also is based upon experience, information as to the status of existing plants, and definite figures of the volume required for new construction.

The "twilight" zone appears to be in the figures for the marketing branch of the industry, containers, and farm and home storage, which account for nearly one-fourth of the total sought.

Red Tape Again

INTERAGENCY differences over the regulations to govern the making of voluntary industry agreements under the Taft antiinflation act have made it necessary for the Oil and Gas Division to request the Department of Justice to extend the time within which the oil industry is required to perfect its arrangement.

Under the clearance granted by Atty. Gen. Tom Clark for the temporary agreement under which the industry has been operating, it was required that a permanent agreement be adopted by April 1.

However, the industry has been unable to go ahead because of the delay in announcing the regulations, due in part to the insistence of the OGD that the problems of the oil industry, over whose agreement it has supervision, differ from those of the other industries, which will be under the jurisdiction of the Department of Commerce.

OGD finally won its battle and prepared its regulations late last week, but this left so little time for the setting up of an industry committee to draft an agreement and the public hearings which must be held before it is adopted, that officials sought additional time, suggesting that the deadline be moved back to the middle of May.

If the Department of Justice falls in with this suggestion, it will give an opportunity for the National Petroleum Council to consider the agreement at its second 1948 meeting, next month.

Tanker Lines

RELAXATION of the load-line rule adopted by the Coast Guard this winter to speed oil deliveries to the East Coast, which is estimated to have added the equivalent of 15 T-2 tankers to the coastwise fleet, will expire March 31 and appears unlikely to be extended.

The heavier loading of vessels has been opposed by the tanker crews, who have endeavored to interest members of Congress in the matter. The complaint is that the heavily laden tankers have no freeboard and the seas wash over them, and it is charged that gasoline and oil spill over the decks. So hazardous is the higher load line considered that there have been intimations that its continuance might lead to the refusal of crews to take the tankers out.

The oil companies are understood to be urging that the relaxation be continued, pointing out that it will be necessary in order to move necessary gasoline stocks this summer, but they also are said to have told the Maritime Commission the transportation problem had been licked and the emergency regulations which kept tankers on the Gulf-Atlantic run were no longer necessary.

The commission apparently took the same view, for it lifted the regulations March 15, much to the surprise of other Government agencies which, reportedly, had not been consulted in advance. And some of the agencies, apparently, including the military, are far from convinced that there are enough tankers in domestic service at the present time.

In the light of the conflicting positions of the industry and the commission, Coast Guard officials are said to be reluctant to extend the load line relaxation.

"Hot Oil" Ball

THE official reaction to Sen. Kenneth S. Wherry's proposal to put a quick end to the oil shortage by suspending the Connaily 'Hot Oil' Act has been just about what could readily have been predicted—a "brush off."

More politely, the White House response to his letter submitting the proposal to President Truman was that the matter would be studied. Any such study, of course, would involve calling in the Interior Department experts, and since the department administers the Connally Act and knows its influence, and also its limitations, there is little likelihood they would see the idea from Wherry's angle.

The senator apparently believes that if the Connally Act were lifted and no support given the state conservation laws, the states would have to increase their allowables or be swamped in a flood of violations which they could not check, and that as a lesser of two evils they would permit the production of more oil.

From the sidelines it would seem that Wherry has been sold on the idea a "Tinkers to Evers to Chance" play is going on in the oil industry with the Bureau of Mines forecasts of demand as the ball which is tossed around by the Connally Act, the Interstate Oil Compact Commission, and state regulatory bodies, all for the purpose of keeping the supply of oil just sufficiently below demand to maintain high prices, which is what Paul Hadlick, special counsel to the Wherry small business oil subcommittee, charges is being done.

Wanted: Legality

PETROLEUM pipe-line companies operating under Interstate Commerce Commission supervision are paying dividends never sanctioned by law and are willing to contribute $60,000 a year toward legitimizing their position.

This situation was disclosed last week when Sen. Clyde Reed of Kansas sought unsuccessfully to secure

Senate approval for acceptance of the fund by the ICC so that it could make a valuation of the pipe lines. The move was opposed by Sen. Joseph C. O'Mahoney of Wyoming on the ground that any regulation by the Government should be independent and free of danger of any influence being brought to bear by those under regulation.

Some years ago a proceeding was brought against pipe-line companies under the Elkins Act. A consent decree was issued by the court, in which it was provided that the distribution of profits by the companies should be limited to a certain percentage of the appraised value of the lines, but Congress has never provided the funds and the ICC has never made the valuation.

In the absence of a valuation, the companies have gone ahead and paid dividends which they believe would be proper under the decree, but are becoming increasingly anxious to have the situation cleared up. Accordingly, they proposed to pay the $60,000 a year which it was estimated a valuation would cost, so that the ICC could go ahead with the job and eventually give them a definite basis for profits distribution.

Military Moves Make Oil Situation Uncertain

WASHINGTON. — Congress next month will decide how far it wants the country to go toward getting on a war footing, and its decision may materially affect the oil-supply situation after July 1.

Before it are pending the recommendations of President Truman for prompt enactment of universal military training legislation and revival of the selective service system until universal training can get under way.

It also has received proposals from Defense Secretary James V. Forrestal for increases in the authorized strength of the Army, Navy and Air Force, currently 350,000 men below the present ceilings.

Forrestal also has urged the stockpiling of strategic materials and a stepping up of the scientific research under the general supervision of the National Security Resources Board.

There is a division of sentiment in Congress on the question of universal military training and the draft, and leaders now are attempting to work out a compromise which would put the draft into immediate effect while hearings on UMT were continued until the trend of the world situation is more clearly defined. There is no split, however, on the question of giving the military services all the money they need to build up to a security level.

Expansion of the military services will mean increased demands for oil which may have repercussions on civilian supplies, but the extent of the increased requirements will not be known until defense officials disclose their entire training and operational program.

Stock-Piling Effective, Cheap, Reeves Declares

STOCK-PILING of petroleum products for any possible national emergency would be much cheaper than constructing stand-by equipment, in the opinion of E. D. Reeves, vice president of Standard Oil Development Co., who spoke before the National Industrial Conference Board, Inc., March 18 in New York.

Other advantages in stock-piling, as seen by Reeves, are:

1. Products can be stored at a location where they will be needed and where it might be impossible to construct stand-by plants.

2. Transportation will not be as much of a problem. In any national emergency, transportation facilities are always overtaxed.

3. It would save manpower as operation of stand-by equipment would necessarily require a certain amount of labor.

4. From a security point, the stockpiling of petroleum products probably would be safer.

Reeves expressed the view that steel tanks above ground would adequately serve the purpose.

29 Buildings Underway on I.P.E. Grounds

THE world's biggest oil show, the 1948 International Petroleum Exposition, was being given its final physical form early this week by more than 300 workmen scattered over the exposition grounds' 20 acres.

Twenty-nine buildings were undergoing either initial construction or extensive remodeling. Construction on others was to begin later this week and early next.

When completed, the buildings, most of which are permanent, will house an estimated 2,000 or more exhibitors. Early this week space for 1,815 industrial concerns had been allocated and still more applications were expected. In 1940, year of the last oil show, there were 628 exhibitors.

A few major exhibits involving machinery had been installed on the grounds last week, but the vast majority were not expected until during the weeks immediately preceding the exposition, to be held May 15-22.

Mid-Continent Supply Co. on March 19 cemented 10¾-in. surface pipe at 230 ft. for its demonstration test well on its exhibition site. The company was planning to begin preparations this week for moving in a rotary rig which will operate during the exposition.

The company will use a 140-ft. derrick mounted on a 14-ft. substructure which will be in operation during exposition hours. While the Bartlesville sand, containing some saturation, underlies the grounds at about 500 ft., Mid-Continent officials said the well was "not expected to find oil."

Only a few yards from the Mid-Continent site a cable-tool spudder early this week had spudded in for another rotary exhibition test.

Surface pipe being run on Mid-Continent Supply Co.'s exhibition well at the International Petroleum Exposition grounds. At the left is the Texas Building, which will house many of the 2,000 exposition exhibitors

Committee Named to Frame Oil Industry Voluntary Agreement

WASHINGTON. — Regulations governing the making of the oil industry's voluntary agreement under the Taft antiinflation act were issued last week by Secretary of the Interior J. A. Krug, coincident with the naming of a 33-man advisory committee which was called to meet in Washington April 1.

A detailed clearance from the Attorney General was appended, and the regulations noted that to avoid conflict with the antitrust laws the activities of the committee are limited strictly to those specified. The committee is not to determine policies nor attempt to coerce any person to participate in a plan nor to comply with any recommendation of the Interior Department.

Functions of the committee are limited to furnishing information and advice and making recommendations to the department at regular committee meetings, as well as to advise and consult on such plans as may be proposed by the department.

The procedure laid down in the regulations calls, first, for consultation with the committee regarding the content of the agreement and, when an acceptable draft has been worked out, a public hearing at which industry labor and the public generally can present their views. The perfected agreement will be sent to the Attorney General by Krug for approval, following which interior will ask each concern individually to participate in the program.

33 Men Appointed

Membership of the committee appointed by Krug is as follows: H. T. Ashton, Western Petroleum Refiners Association; Jacob Blaustein, American Trading & Production Corp.; Russell B. Brown, Independent Petroleum Association of America; H. S. M. Burns, Shell Oil Co.; Fayette B. Dow, National Petroleum Association; John Dresslec, New Jersey Gasoline Retailers Association; R. G. Follis, Standard Oil Co. of California; B. C. Graves, Union Tank Car Co.; B. I. Graves, Tide Water Associated Oil Co.; J. Parks Gwaltney, National Council of Independent Petroleum Associations; George A. Hill, Jr., Houston Oil Co. of Texas; Walter Hochuli, The Texas Co.; W. T. Holliday, Standard Oil Co. (Ohio); W. Alton Jones, Cities Service Co.; B. L. Majewski, Deep Rock Oil Corp.; J. Howard Marshall, National Stripper Well Association; I. A. O'Shaughnessy, Globe Oil Refining Co.; Sidney Swensrud, Gulf Oil Corp.

L. S. Wescoat, Pure Oil Co.; H. C. Wiess, Humble Oil & Refining Co.; Russell S. Williams, Indidually Branded Petroleum Association of America; Robert E. Wilson, Standard Oil Co. (Ind.); John P. Birmingham, White Fuel Corp.; Louis M. Faber, Retail Gasoline Dealers Association; Walter S. Hallanan, Plymouth Oil Co.; John Hancock, Hancock Oil Co.; Harry B. Hilts, Empire State Petroleum Association; Carl A. Johnson, Independent Refiners Association of California; R. L. Minckler, General Petroleum Corp. of California; Glenn E. Nielson, Husky Refining Co.; S. F. Ninesa, Leaman Transportation Co.; Chester S. Smith, Standard Oil Co. (N. J.); Rankin P. Peck, National Congress of Petroleum Retailers.

Forgeries Bring Demand For Export License Probe

WASHINGTON. — Discovery of 15 export licenses covering over $500,000 worth of goods, which apparently had been forged, has set off a thorough investigation of the export license situation by a Senate small business subcommittee headed by Sen. Edward Martin of Pennsylvania.

A committee official said none of the forged licenses so far discovered involved oil or oil steel, but expressed the view that the surface has only been scratched and that further probing will show that a big business in illegal licenses has been built up, possibly by an organized "ring."

George Burrell Receives Hanlon Award

FORT WORTH.—The 1948 Hanlon Award for outstanding service to the natural gasoline and cycling industries was presented to Col. George A. Burrell, president of Atlantic States Gas Co., by the Natural Gasoline Association of America during its twenty-seventh annual convention here this week.

The award, one of the highest merit recognitions in the petroleum industry, was presented by C. R. Williams of The Chicago Corp., president of N.G.A.A., who sketched the recipient's 40 years of scientific and business achievements in a broad field of gas development.

Murrell's association with gas began in 1908 when, as a young chemical engineer with the U. S. Bureau of Mines, he was assigned to study coal mine gases in West Virginia. Analysis of these gases led him to the study of natural gas and liquids obtained from it, and he assisted in experiments being conducted by Frank Peterson and others at Follansbee, W. Va., which produced what was then called "liquid gas." In 1912 the Bureau of Mines published his classic "Liquified Products From Natural Gas, Their Properties and Uses," the first official government report on such products.

He was the first experimenter to make an exact analysis of natural gas, and his papers on this subject, published by the bureau in 1915 and 1916, pointed the way to further research by others. In 1916 he helped design and build a natural-gasoline plant which successfully resisted a patent infringement suit resulting in the invalidation of the then existing absorption patents.

© Bachrach

GEORGE BURRELL

In 1917, with the publication of his book "A Handbook of Gasoline," Burrell became internationally known as an authority on gases. During World War I he located a source of helium gas for use in British dirigibles, and as a colonel in charge of research and development work in gas warfare he was awarded the Distinguished Service Medal. Following that war Burrell formed his own engineering and research organization for the development of equipment for the natural-gasoline and petroleum-refining industries, and in 1925 published the first text on natural gasoline, "The Recovery of Gasoline From Natural Gas."

ECONOMICS OF ANTIDETONANT INJECTOR THROUGH NEW

Automatic Octane Booster FOR ENGINES

by C. H. Van Hartesveldt *

THE development summarized here (from N.G.A.A. presentation at Fort Worth this week) is one of the most interesting developments in petroleum and automotive circles to appear in some time. It concerns a new attachment easily made to any automotive vehicle to permit use of low-octane gasoline for "ordinary driving," but it will automatically feed a slug of antidetonant mixture into the regular carburetor system whenever the engine demands it. The author is vice president, Thompson Vita-Meter Corp. (subsidiary of Thompson Products, Inc., Cleveland).

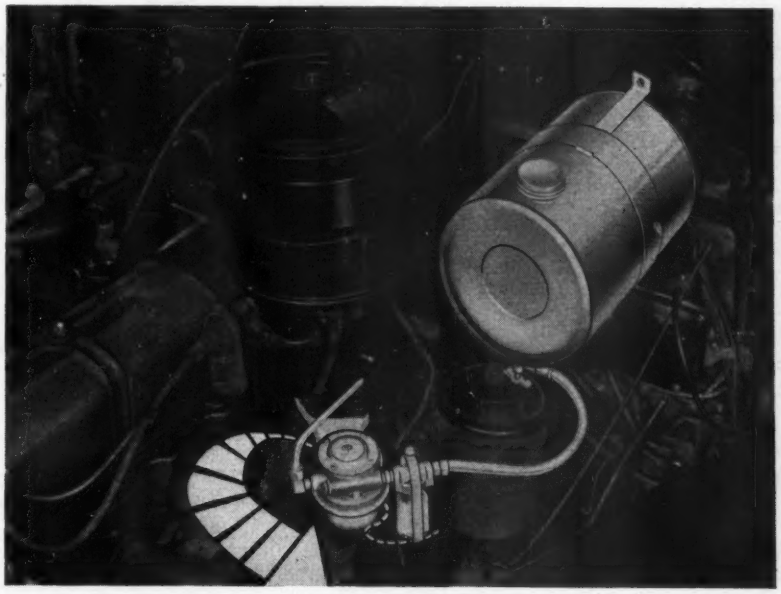
GASOLINE engines require high antiknock quality only when they are at or near full throttle. Most ground vehicles operate under these conditions but a small part of the time, making it economical to supply an antidetonant only when needed.

An alcohol-water-tetraethyl lead antidetonant used through a fully automatic device tradenamed Vita-Meter will give octane numbers at costs competitive with refinery methods. In taxicabs, for example, 19 road octane numbers can be added to a base gasoline at a material cost of 0.46 cent per gallon of fuel.

This new source of antiknock quality can be used in two ways. First, it may be added to low-octane-number, high-burning-quality gasoline to give adequate octane number and important maintenance savings to commercial fleets. Secondly, it can be used with regular and premium grades of gasoline to satisfy the requirement of high-compression-ratio engines. These applications can increase the yield of gasoline from crude oil and decrease refinery investment requirements over the years to come.

Although the construction, distribution, and installation of an antidetonant injector is a problem for

*Vice president, Thompson Vita-Meter Corp. (subsidiary of Thompson Products, Inc., Cleveland). Portion of paper presented at twenty-seventh annual convention of Natural Gasoline Association of America, Fort Worth, March 25.



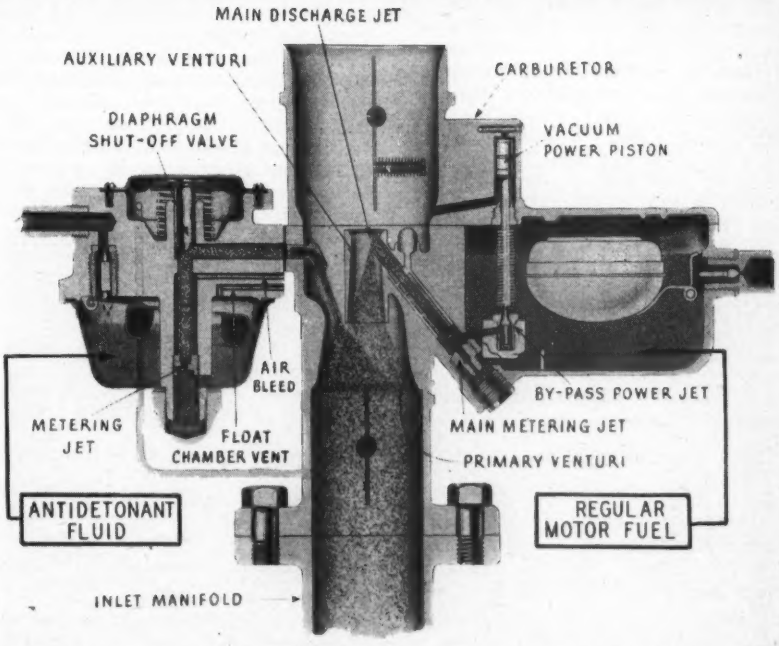


Fig. 1—(Top) Shown in highlight outline is the "octane slugger" in a typical passenger-car installation, together with the 5-qt. tank which holds the antidetonant mixture. Working principle is that the device supplies automatically 12 to 20 or more "jumps" in road octane rating to the regular fuel as the engine demands it, and only then. Fig. 2—(Bottom) Cross-section of the Thompson Vita-Meter (at left), flanged into a production-model carburetor and manifold assembly

automotive equipment manufacturers, the antidetonant solution should be handled by refiners in a program fitted to their antiknock quality needs and consumer demand.

Full Throttle and Part Throttle

A knocking car detonates only when you "step on the gas." This is the same thing as saying part-throttle octane requirements are lower than full-throttle requirements.

A method of administering an antidetonant when needed can be quite simple. We have found that intake manifold pressure should be used as the controlling force for determining when antidetonant is to be added to the fuel-air stream. Fig. 1 shows the new automatic injector and antidetonant tank installed in a passenger car or light truck.

Fig. 2 shows a cross-section of the Vita-Meter and carburetor. Antidetonant fluid is contained in a float bowl according to conventional carburetor practice. High manifold vacuum at idle closes the main valve and no antidetonant flows. This is also true at part throttle. At full throttle the diaphragm spring overcomes the force then exerted by the slight manifold vacuum, the valve opens, and antidetonant flows. The points at which this occurs is set by the spring tension and the amount of fluid drawn in is controlled by the size of the interchangeable jet.

Alcohol-Water Antidetonants

During the war alcohol-water solutions were used in aircraft engines for their antidetonant and coolant properties. With the increased supercharging allowed by the antidetonant effect, an aircraft engine needs more cooling. The supercharger can also compensate for the volume taken by the inert water. A ground vehicle engine does not require as much cooling and the power output is sensitive to displacement of the fuel-air charge by noncombustible matter.

Our laboratory work was done in a Chevrolet 235-cu.-in. truck engine coupled to an electric dynamometer. The coolant was held at an outlet temperature of 170° F. Sump temperature was controlled to 195° F. The engine was run at 1,600 r.p.m. at full throttle on 60-octane-number gasoline. The octane requirement was 80 under these conditions and sufficient solution was injected to reduce the detonation to a trace of knock. The amount required was a measure of the effectiveness of the fluid used.

For a comparison of alcohol solutions, the gasoline consumption was held at normal for the engine. Fig. 3 shows the effects of water and tetraethyl lead in methyl, ethyl, and isopropal alcohols. The vertical scale of the graph is the amount of alcohol used and is proportional to cost for a given antiknock effect irrespective of the concentration used. The horizontal scale is alcohol concentration. Increasing the water concentration, in all cases except for leaded methanol, decreases the alcohol required. Two penalties are imposed, though, with this saving. First, as the water content is increased, less and less antiknock effect can be achieved without loss of power. Secondly, the high-water-content solutions are less effective per unit volume and this means a larger tank on the vehicle and a greater volume of fluid to handle. In other words, water is cheap but it costs money to distribute and carry it. We have no explanation for the unexpected behavior of leaded methanol-water solutions. We checked the results repeatedly because at first we thought they were in error.

For the highest concentration of antidetonant, 100 per cent methanol is indicated as best but the low boiling point of methanol (149° F.) indicates trouble from vapor lock and boiling in the underhood tank. The addition of water raises this boiling point and lowers the cost for ethanol and isopropanol. At 85 per cent concentration methanol and ethanol can be used interchangeably and isopropanol can be used up to equal quantities with methanol in the solution with a negligible loss in effect.

From these considerations as well as the power effect, an 85-15 alcohol-water solution containing 3 cc. of tetraethyl lead per gallon was chosen as optimum. Road ratings of this solution gave the following results:

ROAD OCTANE RESULTS WITH "VITOL" INJECTION

Vehicle—	Octane requirement	Solution injected (Per cent of gasoline at full throttle)	Octane improvement
Dodge truck, WK '47	82	10.0	17
		20.5	27
		30.8	34
Chevrolet truck '46	84	11.2	16
		18.6	26
		30.5	30
G.M.C. truck, Model 300 '46	80	11.3	12
		20.0	22
Pontiac—7.5 comp. ratio '42	85	9.3	11
		20.0	22
		30.5	31
Chevrolet sedan, '46	76	10.5	12
		19.2	20
Ford truck '47	67	9.5	14
Average	..	10.3	13.7
Average	..	19.7	23.4
Average	..	30.6	31.7

Tetraethyl Lead

The solubility at room temperature in alcohol-water solutions of tetraethyl lead along with the ethylene dibromide and ethylene dichloride accompanying it has been found to be as follows:

Alcohol—	Minimum alcohol content for solubility of 3 cc. TEL per gal.
Methanol	73.5 per cent
Ethanol	55.1 per cent
Isopropanol	38.5 per cent

With higher concentrations of these alcohols the TEL solubility increases rapidly. For example, a 75 per cent methanol solution will dissolve 10.35 cc. of TEL per gallon. An 85 per cent methanol solution containing 3 cc. TEL per gallon shows no lead precipitation down to —30° F. A solution of 75 per cent methanol, 10 per cent isopropanol, and 15 per cent water shows no precipitation down to —40° F.

(Continued on page 246)

TABLE 1—COST OF ANTIDETONANT INJECTION AS DETERMINED IN FLEET SERVICE TESTS

Type of fleet—	No. of vehicles	A.S.T.M. Motor octane No. base gasoline	Road octane No. increment added	Gallons of antidetonant per 100 gal. of gasoline	Material cost of antidetonant per gal. of gasoline	Material cost of antidetonant per gal. of gas. per 10 octane Nos.
Antidetonant and Water Solution Containing 45 Per Cent Isopropanol						
Tank trucks†	188	63	8-12	5.5	1.04 cents	1.04 cents
Antidetonant and Water Solution Containing 85 Per Cent Methanol, 3 cc. TEL						
Tank trucks*†	188	63	8-12	2.0	0.42 cents	0.42 cents
Tank trucks, bulk delivery service	27	59	18-20	5.0	1.06 cents	0.56 cents
Tank trucks, bulk delivery service*	27	65	12-14	2.8	0.60 cents	0.46 cents
Tank trucks and trailers	7	59	18-20	10.1	2.12 cents	1.12 cents
Tank trucks and trailers*	7	65	12-14	5.7	1.20 cents	0.92 cents
Taxicabs	3	59	18-20	2.2	0.46 cents	0.24 cents
Taxicabs*	3	65	12-14	1.2	0.26 cents	0.20 cents

*Estimated. †In bulk and home delivery service.

PERSONALS

Clerk to President Is Reward of Hulcy

PRESIDENT of Lone Star Gas Co. for the past 7 years, D. A. Hulcy at 47 was one of the youngest of the company's executives when he was elected to the post. Twenty years earlier he had joined Lone Star as a clerk in its accounting department.

Hulcy's introduction to the industry was not with Lone Star, but with The Texas Co.'s distribution plant at Palestine, Tex., in 1911. The job paid $20 a month, for answering an office phone, but most of his time was spent in delivering drums of gasoline and kerosine from a wagon, he said. A year later he went to work for a 32-mile-long railroad that operated between Rusk and Palestine, and was "in the money," as he put it, at $25 a month. At 21 he married, and had progressed from railroad warehouseman to auditor. In 1920 illness in the family resulted in his moving to Dallas, where he took a job as clerk in the accounting department of Lone Star.

From that point his rise was rapid. In 1923 he was chief clerk of his section and 4 years later was assistant comptroller. In November 1929 the office of assistant to the president was created and he was elected to that position. In 1935 he was on the board of directors and vice president. A year later he became executive vice president, holding that position until he became president in 1940.

Hulcy is widely known in Texas for his interest and active participation in civic affairs. At the present he is serving his second year as president of the Dallas Chamber of Commerce. A partial list of his memberships include: executive board American Gas Association; national executive board and Phillips Properties Committee, Boy Scouts of America; executive board, Independent Natural Gas Association of America. His directorships include: United States Chamber of Commerce, in which he is chairman of the policy and natural resources committees. East Texas Chamber of Commerce; Dallas Citizens Council, Better Business Bureau, and the Rotary Club of Dallas. He is a past president of the Dallas Petroleum Club.

L. L. Sloss, of Northwestern University, Evanston, Ill., and **W. M. Laird,** of the North Dakota Geological Survey, Grand Forks, N. D., coauthors of the paper "Devonian System in Central and Northwestern Montana," have been named as recipients of the president's award of the American Association of Petroleum Geologists. Their paper was selected as the "most significant original contribution to petroleum geology."

Vincent W. Vandiver, chief geologist with Seaboard Oil Co. of Delaware, Los Angeles, is in Venezuela inspecting company concessions.

T. P. Drew, formerly district superintendent for The Texas Co. at Pampa, Tex., succeeds **C. I. Holiman** as superintendent of the company's West Texas-Southeast New Mexico district at Midland. Holiman has resigned to go into the oil business at Ardmore, Okla.

Farrar Newberry, business man of Omaha, Neb., and **Mark H. Adams,** Wichita attorney, have been elected directors of Northern Natural Gas Co., Omaha.

Vance Sibley, production foreman for Stanolind Oil & Gas Co. at Levelland, Tex., has resigned to enter business for himself. He will operate Big State Well Servicing Co. with headquarters at Levelland. He will be succeeded by **L. O. Spears,** formerly at Wink, Tex., for Stanolind.

Charles E. Curry, division engineer and superintendent of the southwestern division for Sohio Pipe Line Co., has been named superintendent of the Grayville division for Sohio, with offices at Grayville, Ill. Grayville is one of the company's two main gathering divisions, and includes the Wabash Valley and western Kentucky. Before joining Sohio in 1944 Curry served with Kentucky Natural Gas Corp. as engineering assistant to the general superintendent and superintendent of pressure stations.

Joseph Nalle, formerly field superintendent for Teci Production Co. at Shamrock, Tex., has become field engineer for the Fairbanks Operators Committee with headquarters in Houston. He succeeds **A. E. Sweeney,**

New officers of Fort Worth Petroleum Engineers Club are (left to right): Gus Athanas, Stanolind Oil & Gas Co., first vice president; R. S. Christie, Amerada Petroleum Corp., president; L. B. Bass, General Electric Co., executive vice president; and Paschal Martin, Pure Oil Co., secretary-treasurer. M. J. Bridges, Wheatley Pump Manufacturing Co., second vice president, is not shown

PERSONALS

Jr., who recently was named director of the secondary-recovery division of the Interstate Oil Compact Commission.

Rear Admiral Thomas E. Boyce (Ret.) has been appointed superintendent in charge of the newly created marine department of Stanolind Oil & Gas Co. Stanolind soon will begin drilling at four offshore Gulf Coast locations. In announcing creation of the department March 24, **J. E. Rouse,** vice president in charge of operations, said the drilling program will be featured by the use of a permanent platform for the entire drilling operation rather than the use of a floating barge tied to the drilling platform.

Thomas L. Cubbage, formerly plant superintendent of the government-owned Plains Butadiene plant at Borger, Tex., which is operated by Phillips Petroleum Co., has joined Stanolind Oil & Gas Co. as operating superintendent in the manufacturing department. He will supervise the operations of Stanolind's gasoline and cycling plants and its refinery at Superior, La.

Don M. Mattocks, attorney and assistant secretary for Warren Petroleum Corp., has been elected secretary of Warren and its subsidiaries. Mattocks joined Warren in 1940 as an attorney and later was named assistant secretary. Since 1946 he has been first assistant to **James E. Allison,** vice president and general counsel. Mattocks succeeds **John T. Oxley,** who recently resigned to become president of Texas Natural Gasoline Corp., an affiliate of Edwin B. Cox and Jake L. Hamon, Dallas.

Irving T. Schwade, member of the geological staff at the Richfield Oil Corp. division office in Midland, Tex., has been transferred to the Ventura, Calif., office. He will be succeeded by **Fred Douglass,** a graduate of the University of Colorado.

J. R. Vandever, division superintendent of the North and West Texas production division at Fort Worth for Sunray Oil Corp., has been named assistant to the general superintendent, **H. O. Harder,** at Tulsa. Other changes in the production department personnel were: **C. F. McCarroll,** gas engineer at San Antonio, has been named technical assistant in the production department general offices at Tulsa. **H. J. Stewart,** formerly West Coast engineer for Sunray, has been transferred to the Gulf Coast division at Alice, Tex., as division engineer and assistant division superintendent. **Perry A. Gill,** formerly in the Fort Worth offices, has been named division engineer and assistant division superintendent at Midland, Tex. **Vic McGowen,** also of Fort Worth, has been transferred to Midland as office manager. These changes accompany Sunray's moving its North and West Texas production division headquarters from Fort Worth to Midland.

Carlton H. Schlesman has been appointed division head of the engineering department, Laboratory of Naval Ordnance now located in Washington, D. C. Later he will be headquartered permanently at the new location of the laboratory near White Oak, Md. Schlesman has been with Socony-Vacuum Oil Co., Inc., since 1925, and was an associate manager of the company laboratories up to the time he joined the Navy.

Foreign guests who attended the recent meeting of the Los Angeles chapter of Nomads were: (Seated) Jean P. Lacroix, Regie Autonome des Petroles; S. L. Slaughter, Tropical Oil Co.; and A. F. Driskill, Iraq Petroleum Co. (Standing) A. C. Bush and H. E. Johnson, Drilling & Exploration Co.; and F. R. Wilmer, Creole Petroleum Corp., Maracaibo

Leonard C. Ritts, formerly president of Devonian Oil Co. prior to the acquisition of that company by War-

L. C. RITTS

E. S. CALVERT

R. R. PORTERFIELD

H. F. BEARDMORE

ren Petroleum Corp., has been elected chairman of the board of Warren Oil Corp., a subsidiary of Warren Petroleum. **E. S. Calvert,** formerly vice president of Devonian, and **R. R. Porterfield,** formerly secretary of Devonian, have been named vice presidents and directors of Warren Oil. **H. F. Beardmore,** who recently resigned as production engineer for Barnsdall Oil Corp. to join the Warren Oil, has been named vice president and a director.

A. J. Hintze, chief geophysicist for Phillips Petroleum Co., Bartlesville, Okla., is on an inspection trip of Phillips' concessions in Venezuela.

C. E. Leheca, with Sun Oil Co.'s geological research department in Dallas, has been assigned to the Corpus Christi area for several months' work in connection with offshore exploration and other operations.

Roland Gouldy, petroleum engineer for Bridwell Oil Co., has been elected chairman of the North Texas American Petroleum Institute section at Wichita Falls, Tex. He succeeds **Bruce Davidson,** division engineer, Humble Oil & Refining Co. **W. C. Lenz,** assistant division superintendent, The Texas Co., has been elected secretary and treasurer. Vice chairmen named were: **K. C. Gee,** Schlumberger Well Surveying Corp.; **Tom Morton,** Halliburton Oil Well Cementing Co.; **J. M. Terry,** Lane-Wells Co.; **N. A. Tinker,** Gulf Oil Co.; **Joe Hayes,** Tide Water Associated Oil Co.; and **H. K. Holland,** Magnolia Petroleum Co.

Stuart Hunter has joined Hunt Oil Co. at Midland, Tex., as assistant to **A. N. Griffith,** superintendent of drilling and production in the West Texas-New Mexico area for Hunt and affiliated companies.

W. J. Barnett, formerly assistant district superintendent for Creole Petroleum Corp. at Jusepin, Venezuela, has been transferred to the production department in Caracas.

W. R. Donnell and **W. Lee Tharp,** geologists, have joined the Permian basin district office of Anderson-Prichard Oil Corp. in Midland. Donnell was formerly with Magnolia Petroleum Co., at Roswell, N. M., and Tharp was formerly with The Texas Co. in Midland.

G. T. Buskirk, formerly district geologist at San Antonio for Stanolind Oil & Gas Co., has been named division geologist in charge of Stanolind's exploration office in Bogota, Colombia. Buskirk's staff will include the following Stanolind men who will be transferred from the United States: **J. H. Chivers,** formerly geologist in the Casper, Wyo., office, geologist; **J. W. Vanderbeek,** formerly geological scout at Wichita Falls, Tex., geologist; **J. A. Thompson,** formerly an assistant section head in the accounting department, Tulsa, office manager; **W. A. Sidwell,** formerly landman at Houston, landman; **Jack Hunter,** who recently received his master's degree in geology from the University of Texas, geological scout; and **Frank Crespo,** formerly in the land department, Tulsa, clerk. Stanolind personnel who have been named to the Canadian division at Calgary, Alberta, are: **R. W. Craig,** formerly geologist at Lake Charles, La., senior geologist; **W. B. Longshore,** formerly landman at Casper, Wyo., senior landman; **T. B. Hewitt,** formerly senior clerk at Jackson, Miss., landman; and **J. H. Helland,** formerly in the San Antonio office, geological scout.

Earle W. Webb, chairman of the board of Ethyl Corp., has retired after nearly 23 years of service. He will remain in the New York offices and continue to serve as a director, but has reliquished all administrative duties.

Paul L. Lyons, Warren Oil Corp., Houston, has been named to the newly created position of manager of the land department. Lyons, prior to joining Warren in 1945, was chief scout for Standard Oil Co. (Ind.). In 1930 when Standard acquired Sinclair Crude Oil Purchasing Co. and Sinclair Pipe Line Co., Lyons was named chief scout. He previously had been associated with Sinclair Crude Oil Purchasing Co., Consolidated Oil Corp., and Sinclair Oil & Gas Co.

SHIFTS—

E. A. Olson, engineer, Standard Oil Co. of California, Sherman Oaks to Norwalk, Calif.; **Clifford L. Walter,** engineer, Shell Chemical Corp., Lynwood, Calif., to LaPorte, Tex.; **J. P. Mead,** engineer, Superior Oil Co., Eagle Lake to Conroe, Tex.; **Edward Strunk,** engineer, Phillips Petroleum Co., Sweeny, Tex., to Bartlesville, Okla.; **R. E. Mitchell,** engineer, Shell Oil Co., Inc., Columbus to Houston, Tex.; **C. H. Otto,** foreman, Sinclair Refining Co., Arp to Kilgore, Tex.

P. C. Barbour, foreman, Gulf Research & Development Co., Beeville to Rosenberg, Tex.; **L. K. Grove,** engineer, Great Southern Corp., Corpus Christi to Beaumont, Tex.; **Delam Baucum,** superintendent, Humble Oil & Refining Co., Denver City to Freer, Tex.; **Perry Gill,** engineer, Sunray Oil Corp., Ft. Worth to Midland, Tex.

J. R. Vandever, superintendent, Sunray Oil Co., Fort Worth, Tex., to Tulsa, Okla.; **R. M. Wemple,** engineer, Pan American Production Co., Lyford, Tex., to Easton, La.; **William C. Wunnicke,** engineer, Stanolind Oil & Gas Co., Odessa, Tex., to Tulsa; **Walter W. Florence,** engineer, J. S. Abercrombie Co., Old Ocean to Conroe, Tex.; **C. C. McNeil,** foreman, Humble Oil & Refining Co., Wink to Denver City, Tex.; **J. R. McLaughlin,** engineer, McAlester Fuel Co., Magnolia, Ark., to Norman, Okla.

C. W. Gore, superintendent, Markhan Drilling Co., Mount Vernon, Ill., to Cisco, Tex.; **O. M. Brooks,** superintendent, United Asphalt Corp., Shubuta to Brookhaven, Miss.; **Milo B. Watkins,** foreman, The Texas Co., Cut Bank to Roundup, Mont.; **Eugene F. Lewis,** engineer, Phillips Petroleum Co., Oklahoma City to Dewey, Okla.; **S. B. Ingerson,** chemist, Phillips Petroleum Co., Okmulgee, Okla., to Kansas City, Kans.; **D. R. Mason,** superintendent, Phillips Petroleum Co., Shidler to Oklahoma City; **Rex E. Cheek,** engineer, Stanolind Oil & Gas Co., Tulsa, to Ulysses, Kans.

DEATHS

L. E. Doan, 85, an early day oil operator of California and prior to his retirement in 1942 affiliated with North American Oil Consolidated, San Francisco, as director, vice president and general manager, died March 7 in Oakland, Calif. From 1918 to 1930 he operated the Doan Oil Co. at Shreveport, La.

Allmand M. Blow, 57, vice president and manager of Amerada Petroleum Corp., died March 21 in Tulsa. Blow, a graduate mining engineer from Columbia School of Mines, New York, joined Amerada soon after World War I.

Edward M. Ryan, 55, member of the controller's department of The Texas Co. in Houston and associated with the company 32 years, died March 15 in Alexandria, La.

Elmo J. Ehinger, 47, purchasing-stores representative in the Houston area for Shell Oil Co., Inc., died March 18 in Houston. Ehinger had been with the Shell organization 22 years.

Harold J. Lawall, 68, assistant to the vice president of operations of United Gas Improvement Co., died March 10 in Byrn Mawr, Pa.

SIGNIFICANCE OF Liquids FROM Natural Gas

by C. R. Williams

The author, president, Natural Gasoline Association of America, says in this article, "... During 1948 and 1949, the largest expansion program in the history of this industry is under way ... Upon completion of this plant construction program in 1949 ... the estimated natural-gasoline and L.P.G. production ... will be increased 45.4 per cent over that for 1947."

Williams is vice president of Chicago Corp., Corpus Christi, Tex., and his paper given here was presented at the twenty-seventh annual convention of the N.G.A.A. at Fort Worth, March 24-26.

THE significant thing about liquids from natural gas is that in 1947, the total production amounted to 130 million barrels, which roughly is equivalent to the reserves from the discovery of 12 average oil fields. The increase alone in 1947 was 16,300,000 bbl., or an amount equivalent to the annual production from 10 good oil fields. The recovery of these products is really a huge conservation measure resulting in the corraling or salvaging of materials that otherwise would not have been recovered. Without this processing of gas the American public and American industry would have been denied the comforts and necessities these products afforded during this critical period of shortages of petroleum products.

The history of the natural-gasoline industry is such that there has never been a marker established to which succeeding periods of production can be compared to determine whether or not a so-called record may have been set or passed. The industry has never decelerated for a sufficiently long period of time to determine such values. While curves reflecting the liquid production from gas do contain a few valleys, the underlying cause cannot be attributed to lack of progress from either a technical or industrial standpoint. This fact is borne out by the steadily growing importance of these liquids since the 1920's. It was at that time the volume blended in motor fuels started its upward climb and some grades of natural gasoline began to go into the motor-fuel market by direct sale from the plant to the consumer. Since the inception of the cycling plant, the direct sale of products from gas has become a first-class competitor of the refineries for a share of the expanding domestic motor-fuel market.

Table 1 discloses the significance of the production of liquids from natural gas in 1947, and also compares the production in 1947 with that of 1946. Note that production of natural gasoline and heavier fractions increased 5.9 per cent in 1947 above that of 1946, while the liquefied petroleum gases production increased approximately 11,000,000 bbl., or an increase of 34.1 per cent over 1946. From this table it is seen that the total production of all liquids from gas was in excess of 5 billion gallons, or approximately 130 million barrels in 1947.

Fig. 1 shows the liquid production from natural-gas processing plants in millions of barrels annually from 1918 through the 1947 estimated production. The bottom curve shows the quantity of liquids from natural gas that were sold directly to the consuming public and not used as a blending material in refinery types of gasoline. Undoubtedly, the 1947 increase is a result of the gasoline and fuel shortages, and whether

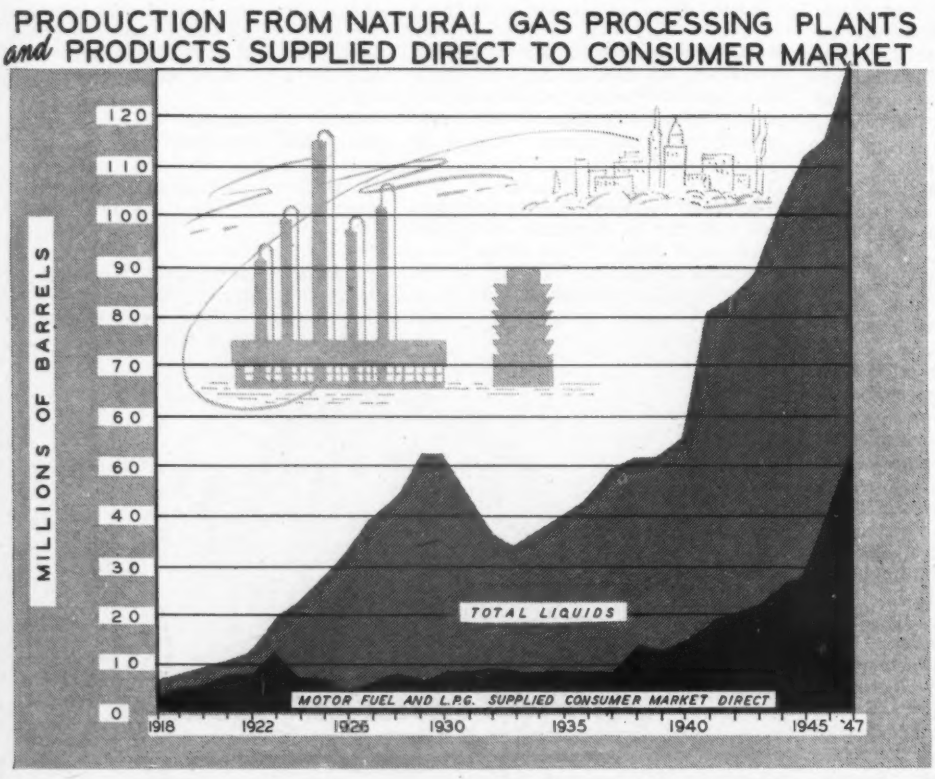


Fig. 1—Production by years from natural-gas-processing plants, millions of barrels annually

TABLE 1—COMPARATIVE YEARLY PRODUCTION OF LIQUIDS FROM NATURAL GAS
(Volumes in thousands of gallons)

	1947	1946
Natural gasoline	2,409,658	2,347,619
Natural-gasoline mixture	334,179	343,382
Raw condensate	410,051	350,183
Finished gasoline and naphtha	428,202	355,113
Other products	72,430	55,391
Total	3,654,520	3,451,688
Increase	202,832 = 5.9%	

Liquefied petroleum gases:	1947	1946
Commercial propane-butane mixture	477,711	420,521
Normal butane	442,533	339,532
Propane	556,803	327,163
Other L.P.G. mixture	166,025	121,879
Isobutane	206,184	164,015
Isopentane	40,268	36,235
Total	1,889,524	1,409,345
Increase	480,179 = 34.1%	

All liquids:	Gallons
Total for 1947	5,544,044,000
Total for 1946	4,861,033,000
1947 increase	683,011,000
1947 increase, per cent	14.05

or not this tendency continues will depend upon the supply and demand of these materials in the future.

In order that we may glimpse the future potentialities of liquids from gas and consider their significance through future years, Fig. 2 is used to reflect the total reserves of natural gas and the production from these reserves by years from 1919. While the production of gas since 1919 has increased almost fivefold, the reserves of gas have increased more than tenfold. Of course, one cannot predict what the future will bring. It is thought that the deeper drilling will continue to find new reserves. Quantities produced from the reserves are continually expanding, and due to the large pipe lines transporting the gas from the gas fields to the East and West Coasts, markets are growing at an unprecedented rate. One can only conclude that liquids produced from natural gas will also continue to increase in quantity and become even more significant than at present.

A comparison of the increase in liquid production with the increase in gas sales is reflected in Fig. 3. It readily can be seen that as additional quantities of gas are produced from the reserves, ever-increasing quantities of liquid materials are recovered.

Significance of liquids from gas and their effect on the petroleum industry's over-all economy is necessarily a function of the geographic location of production. Fig. 4 shows separately the producing capacity of natural gasoline and of liquefied petroleum gases by states in the United States. The shaded circles in each state indicate the percentage of natural-gasoline producing capacity in that state as compared with the total

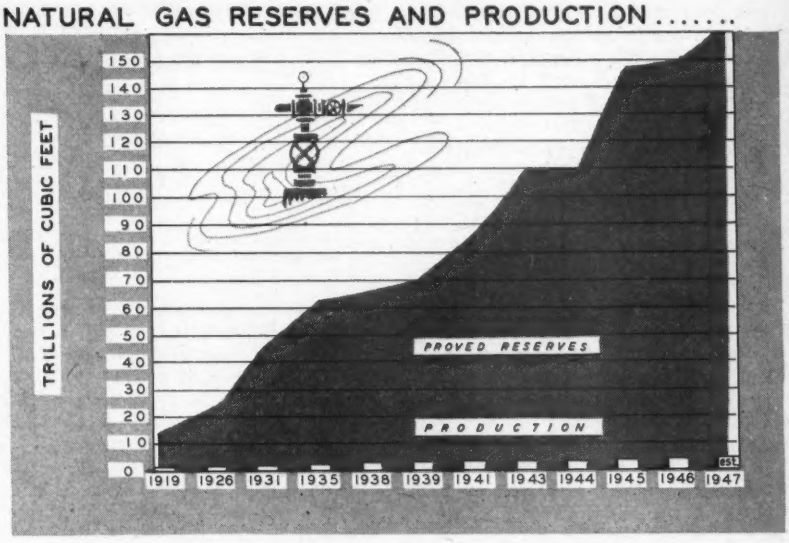


Fig. 2—Proved reserves of natural gas have increased greatly in 20 years

capacity in the United States. The figures in the clear circles indicate similar percentages of liquefied-petroleum-gas producing capacity within the state. The bottom scale compares graphically the production capacity by the various states producing liquids from natural gas and also shows the number of plants now known to be active within those states.

Texas' capacity to produce is 48.3 per cent of the natural gasoline produced from gas, and 42.6 per cent of the liquefied petroleum gas in the United States. Texas has 162 known plants. California is second to Texas with 73 plants, and Louisiana with its 31 plants runs Oklahoma, with 81 plants, a close third in the capacity to produce liquids from gas.

Fig. 4 also shows there are only 16 producing states in the United States, and that the plants producing in 1947 total 442 in number. These plants were operated at 83.5 per cent of their total active liquid capacity in 1947. This figure also shows that the three states, Texas, Oklahoma, and Louisiana, had capacity to produce over 68.5 per cent of the natural gasoline

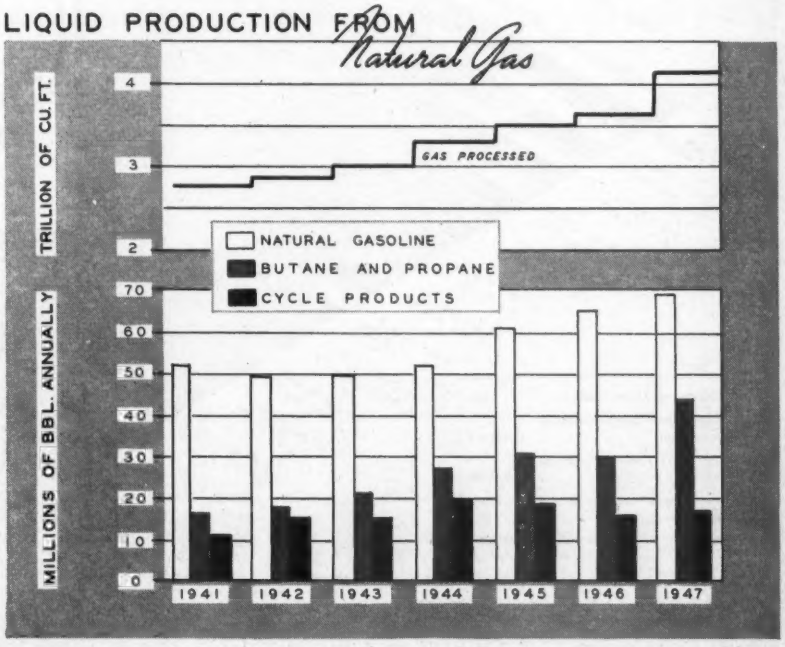


Fig. 3—Comparison of increase in production of light hydrocarbons with gas processed

and 56 per cent of the liquefied petroleum gases in the United States during 1947. The concentrated production of these materials in the south central portion of our nation results in a severe transportation problem to distribute these volatile materials to the consuming public.

Table 2 tabulates the estimated disposal of these materials in 1947, compares the 1947 distribution with that of 1946, and also shows the percentage increase to the various consumers. In 1947, distribution of natural gasoline and condensate direct to jobbers and trade outlets increased 24.7 per cent and liquefied petroleum gas for fuels increased 43.6 per cent over 1946. Comparing Table 2 with Table 1, it is noted that the natural-gasoline and heavier fractions distributed in 1947, approximately 83 per cent was distributed to refineries for blending and further processing, and approximately 15 per cent was sold directly to the consumer. Of the liquefied-petroleum-gas-type production, the refiner received only 22 per cent in 1947. Not all liquefied petroleum gas is produced from natural gas. In addition to that produced from natural gas, approximately 18,300,000 bbl. were produced by the refineries from gas resulting from the cracking of crude petroleum. This is about 28 per cent of all L.P.G. produced.

TABLE 2—COMPARATIVE YEARLY DISTRIBUTION OF LIQUIDS FROM NATURAL GAS
(Volumes in thousands of gallons)

	Shipments to refineries		To jobbers and trade outlets			
	Natural gasoline and raw condensate	Liquefied petroleum gases	Natural gasoline and condensate	L.P.G. for fuel	L.P.G. for chemicals	Exports and unaccounted for
1947	3,031,056	407,479	541,755	1,238,189	242,280	160,895
1946	2,851,321	381,175	434,547	862,229	209,394	154,231
Increase, volume	179,735	26,304	107,208	375,960	32,886	6,664
Increase, per cent	6.3	6.9	24.7	43.6	15.7	4.3

Fig. 5 shows the marketed production of liquefied petroleum gas, both from the natural gasoline and refining industries, excluding that used for synthetic rubber and aviation gasoline. Domestic uses constituted 54.7 per cent of that marketed in 1947. This type of market probably covered that used for such purposes as home cooking and heating and operation of farm machinery. Chemical manufacturing consumed 22.5 per cent for the production of such compounds as formaldehyde, acetone, alcohol, and synthetic materials. Industrial uses constituted 15.5 per cent for such purposes as fuel in internal-combustion engines, gasoline blending, standby furnace fuels, transportation and preservation of agricultural products, and as a supplement to natural gas in the manufacture of carbon black. Gas manufacturing and enrichment required 7.3 per cent as a supplement to, or enrichment of natural gas and

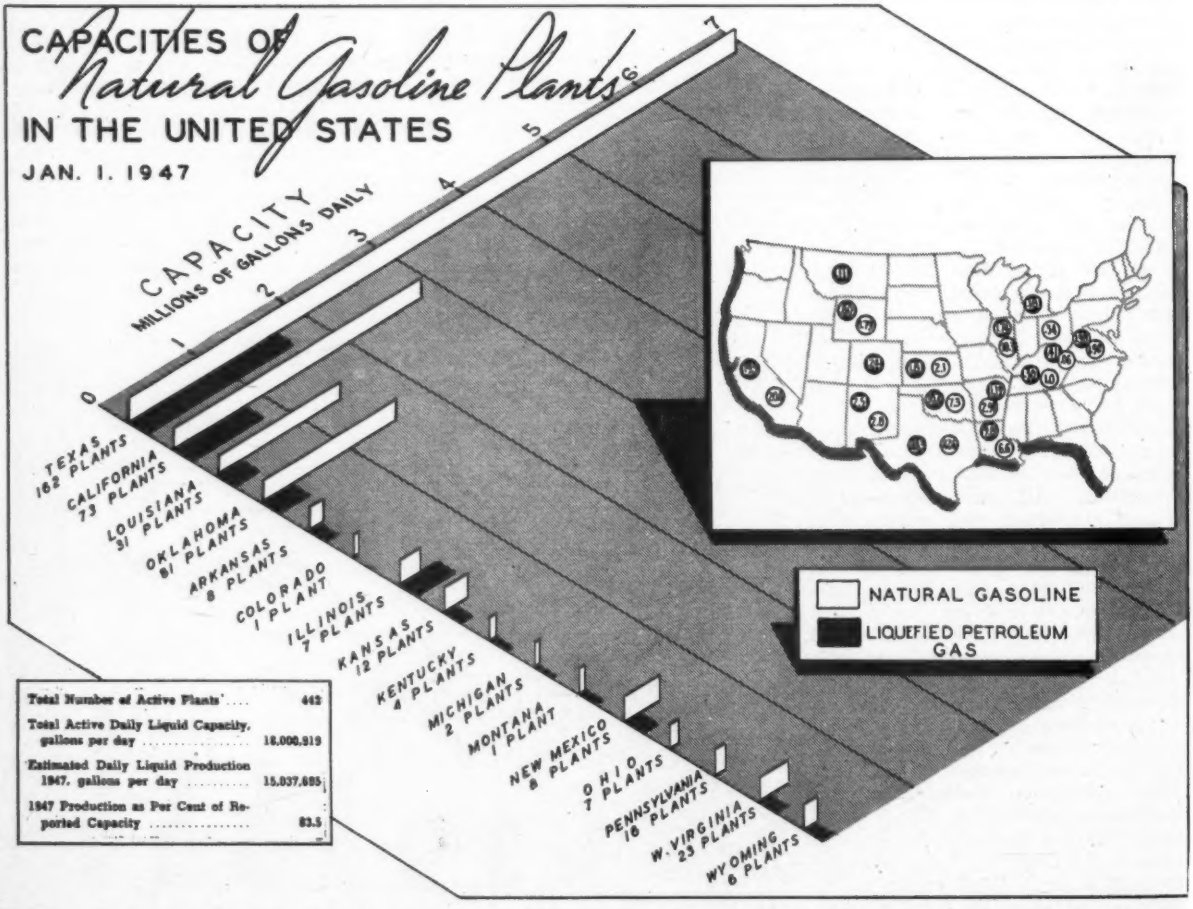


Fig. 4—Map showing distribution of natural-gasoline and L.P.G. plants. Figures in the shaded circles indicate percentage of natural-gasoline producing capacity of a state, as compared with total U. S. capacity. Figures in clear circles give same percentages for L.P.G. producing capacity

in several instances as a complete replacement of manufactured or natural gas for entire communities.

The largest L.P.G. consumer indicated in domestic use is John Q. Public, and since his use and demand are seasonal, he poses one of the most difficult problems from the standpoint of marketing in that storage of summer production is required to supply his winter needs. It is estimated that steel storage now costs from 35 to 40 cents per gallon for propane, and from 20 to 25 cents per gallon for the butanes. This cost can vary with locality and average regional temperatures. The capital investment required for storing his winter needs is colossal, and seriously increases the cost of the material to him during his consuming season. He could save some of this cost by building his own storage. It would improve the industry's service to the consumer if such installations were made by him.

While it may be possible to use subterranean sand reservoirs for storage, the selection of a suitable reservoir is most difficult and there is no immediate assurance that even a reasonable portion of the liquids thus stored can be recovered. Obviously, this kind of storage could be a financial hazard. Yet, there are several known instances where companies are using such underground storage, and several more instances where supplementary storage of this kind is being sought. It is believed that this type

(Continued on page 188)

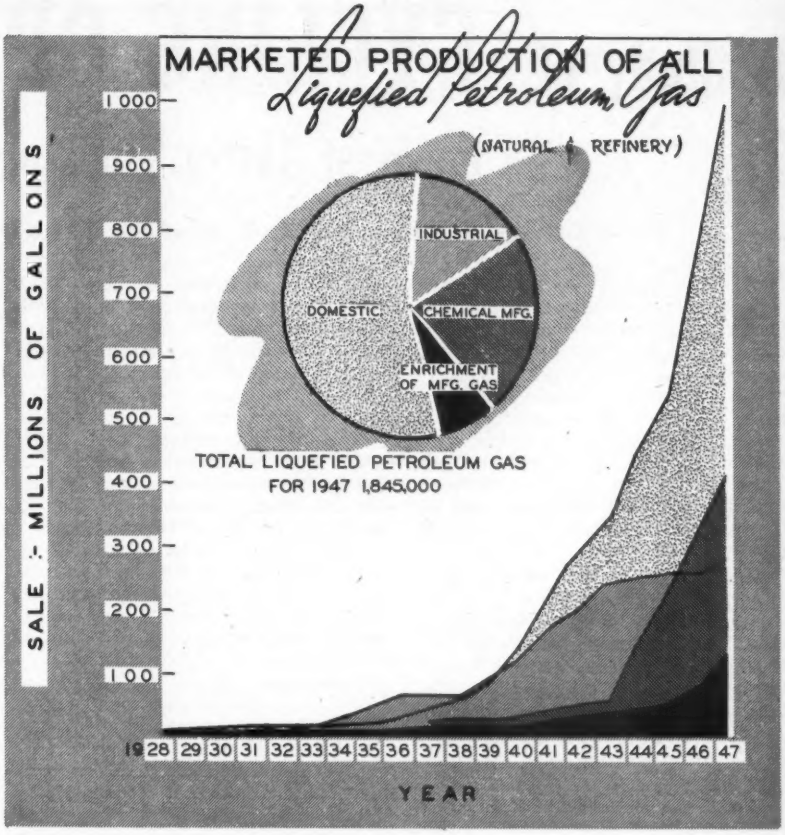


Fig. 5—L.P.G. market data, by years and by type of use

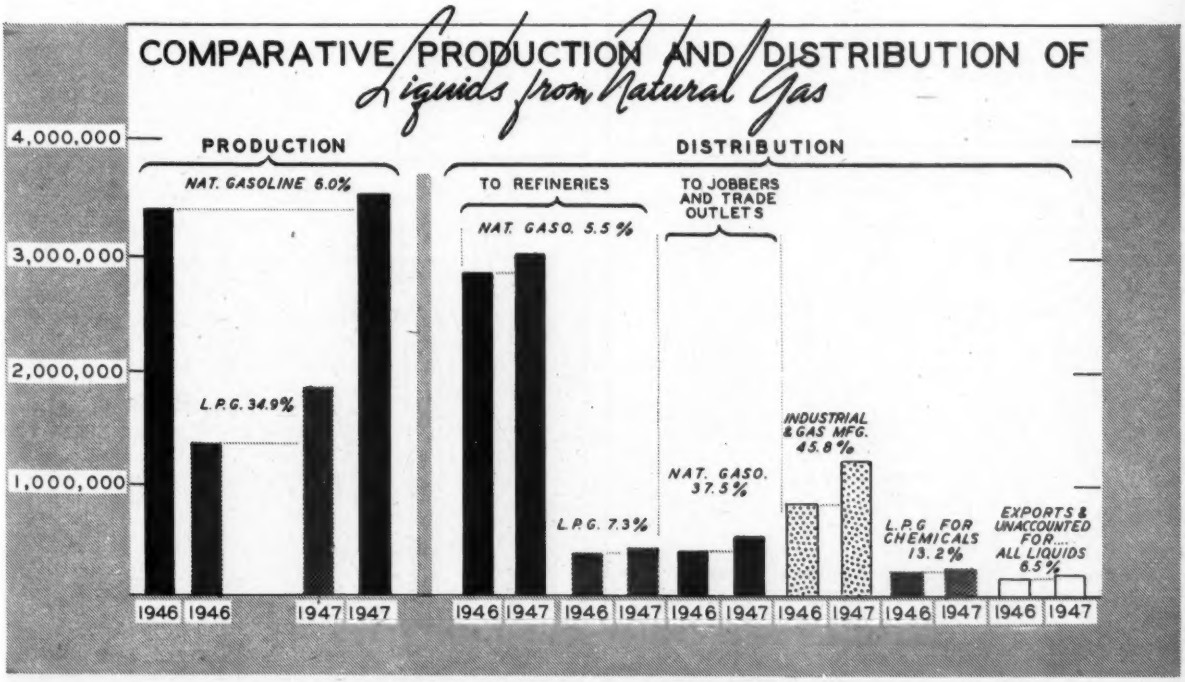


Fig. 6—Production and distribution data, by years

A Study of CYCLING OPERATIONS

In the West Austin Sands of Stratton-Agua Dulce

by Charles B. Johnson, Jr. and Dr. Frank H. Dotterweich†*

THE West Austin sands of Stratton-Agua Dulce fields in Nueces and Jim Wells counties, Texas, occur in the lower Frio-Vicksburg geologic series at an average depth of 6,650 ft. There are two separate reservoirs, each consisting of a series of sand lenses, separated by a blanket shale barrier ranging from 10 to 60 ft. thick. The reservoirs are closed by faults on both the east and west sides and by lensing out into shale on the north and south.

This sand series was discovered in June 1941 when the first well was completed as a dual producer from both the upper and middle sands. Following discovery, exploitation was at a relatively steady rate, and 12 of the ultimate 16 wells (13 duals and 3 singles) were completed by June 1942. Fig. 1 shows isopachous maps of both reservoirs and the location of the wells. The thickness indicated is net productive sand as determined from drill-stem tests and electric logs. The upper Austin covers 3,975 surface acres and the middle 3,111 acres, which with 16 original completions in the former gives a density of 1 well per 248 acres while the latter has 13 wells or 1 per 239 acres.

The stratigraphy is illustrated in Fig. 2, which is a northeasterly-southwesterly cross-section including injection wells, Rivers A-2 and Wardner 23, which are on opposite sides of the structure. It is apparent from this cross-section that cycling efficiency might be impaired due to an irregular dry gas front as a result of the multiple sand lenses. The original pattern as determined from electrolytic model studies, although thickness variations were uncompensated for, indicated ultimate efficiencies of better than 70 per cent for the upper and middle Austin sands.

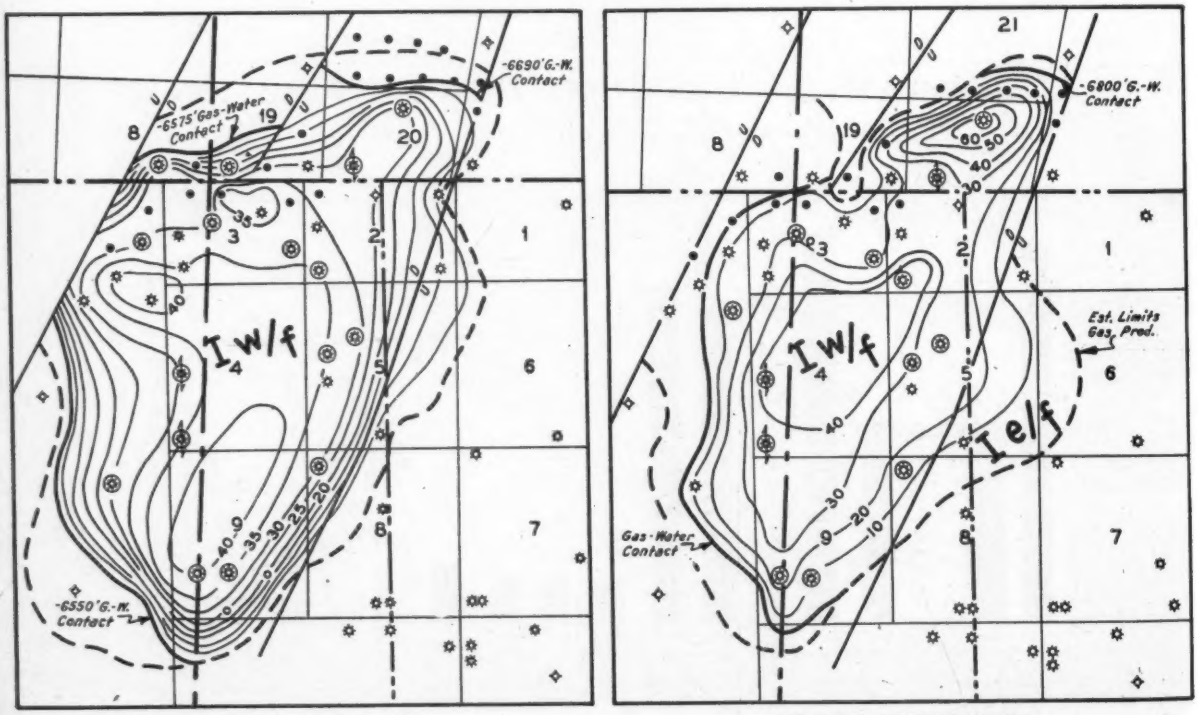
*Chief engineer, The Chicago Corp., Corpus Christi, Tex., and †Director, division of engineering, Texas A. & I. College, Kingsville, Tex. Paper presented at the twenty-seventh annual meeting of the Natural Gasoline Association of America at Fort Worth, March 24-26, 1948.

Operational History

At the time of discovery of these sands, there was only a small market for the residue gas from the field which was divided proportionately among the numerous producing sands. For this reason, although the rate of production was reasonably high, the net withdrawal was erratic. Fig. 3 (U) shows the net voidage from the upper Austin from inception until January 1, 1948, and the reservoir pressure performance during this same period of time. The increased net withdrawal in November 1944 is coincident with the opening of a substantial market for the residue gas at which time a volume of gas equivalent to 43.8 per cent of the estimated original recoverable reserves, by depletion, had been processed.

August 1, 1945, the reservoirs were placed under a pressure-maintenance

Fig. 1—Isopach maps of the two reservoirs. Upper Austin covers 3,975 acres; middle Austin 3,111 acres



UPPER AUSTIN SAND

MIDDLE AUSTIN SAND

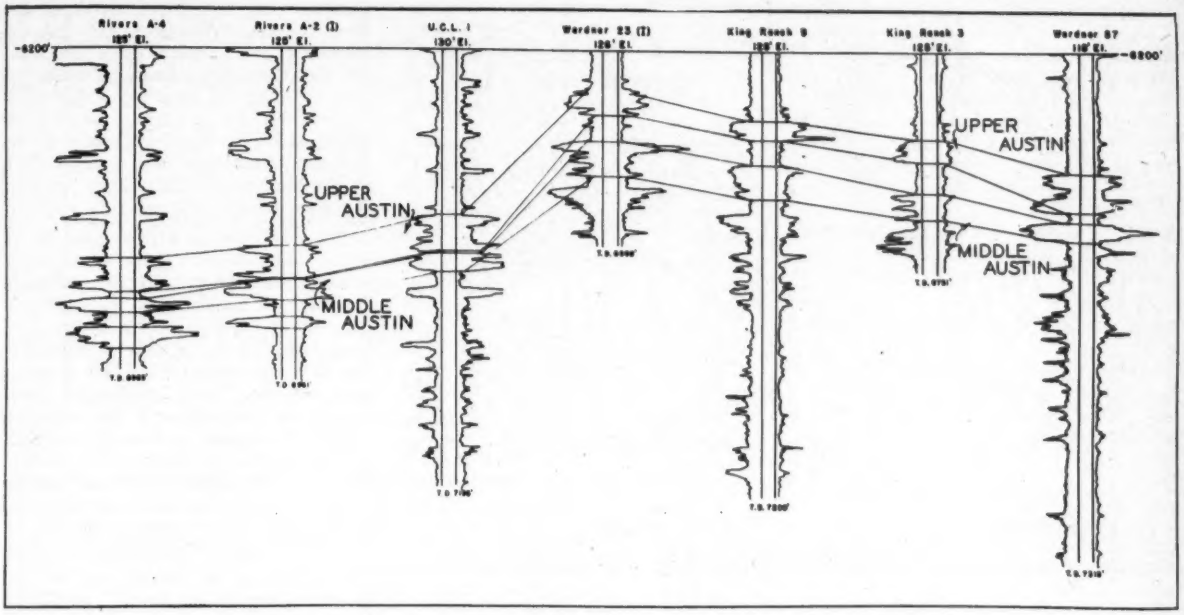


Fig. 2—Northeast-southwest electric log cross-section of Stratton-Agua Dulce fields

order, and there was no net voidage from this date until June 1947 when the order was lifted. By this time the total volume of gas processed was 63.1 per cent of the estimated original recoverable reserves. The pressure trend throughout is normal for this type reservoir and substantiates the theory that there is no external drive.

Fig. 3 (M) gives corresponding data for the middle Austin and the processed volumes were 46.4 per cent of estimated original recoverable gas November 1944, and 59.7 per cent by June 1947.

At the instance of the pressure-maintenance order, the wells on the Wardner lease and King Ranch were closed in and remained inoperative until June 1947, but the remaining wells continued on regular operating schedules throughout.

Dilution of Wet Gas

Periodic liquid content tests are made using a portable laboratory with miniature processing equipment and testing procedure as outlined by the N. G. A. A. High-Pressure Gas-Sampling Committee.[1] The reported data include separated liquid/vapor ratio; adsorbed liquid/vapor ratio; gas gravity, and liquid gravity of the separator residue.

As described by Lewis,[2] the data from this gas-sampling report may be used to detect the influx of dry gas into a well in cycling operations by weighing the change in liquid content, gas gravity, and liquid gravity. In this analysis it was found that the most consistent correlation could be obtained by comparing the sum of the separator and adsorbed liquid content measured at various periods. To minimize discrepancies between individual tests, a smooth curve was made for obtaining average points applicable to particular periods.

From a study of the records of the Austin sands to April 1947, dilution diagrams were constructed for each reservoir. The dilution was determined by the equation:

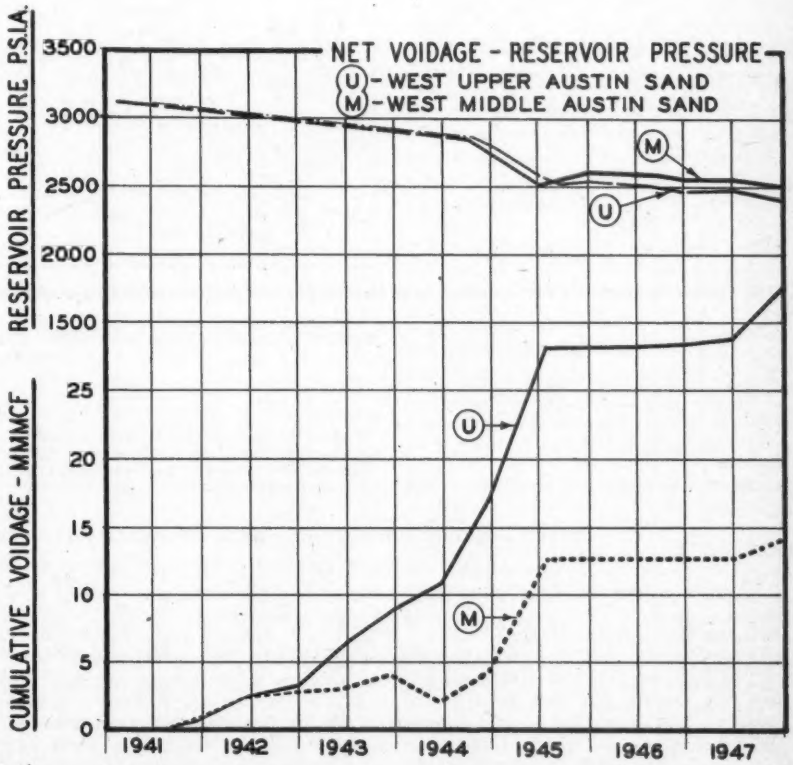


Fig. 3—(U and M) Reservoir pressure and net voidage plotted against time

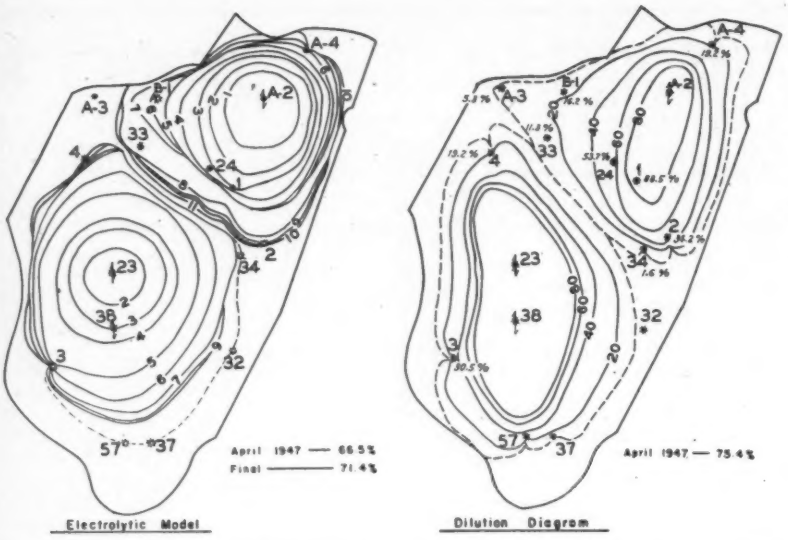


Fig. 4 (U)—West upper Austin, comparison of electrolytic model studies and dilution diagrams

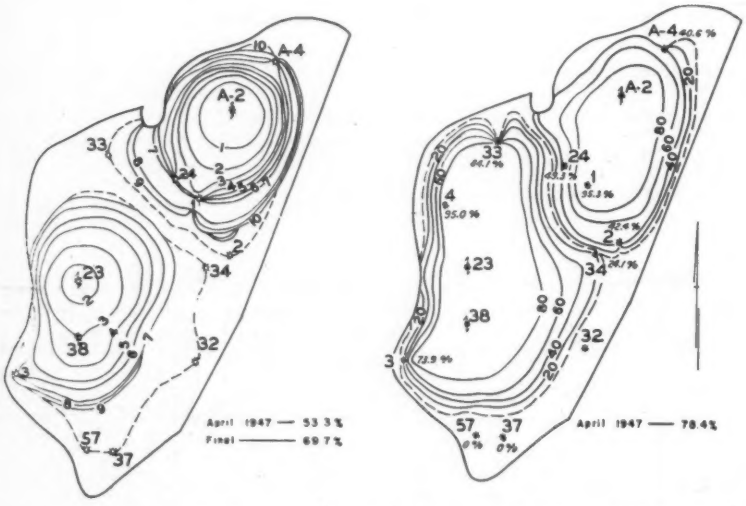


Fig. 4 (M)—West middle Austin, comparison of electrolytic model studies and dilution diagrams

dilution diagrams, electrolytic models were set up at Texas A. & I. laboratory. Fig. 4 (U) and Fig. 4 (M) show the resulting correlation between the two methods of estimating the position of the dry gas front. It is to be noted that the final efficiencies determined from the electrolytic models at this date are within close limits to those originally estimated in 1944.

The variance in efficiencies, as of April 1947, between the electrolytic model data and the dilution diagrams (Fig. 4) is a measure of the conformance of the dry-gas sweep. The contour lines on the model studies represent the position of the dry gas-wet gas interface at a particular time while the contours on the dilution diagrams connect points of equal dilution which is expressed as per cent dry gas. The higher efficiency shown by the dilution diagrams as compared to the models is a measure of thickness-permeability relations.

Resumption of operations of the Wardner and King Ranch wells, on termination of the pressure-maintenance order, provided liquid-content data not available for the first dilution diagrams. On correlating this new data with that at the end of operations in July 1945, it is seen from Table 1 that although inoperative for 23 months, Wardner 34, 57, and King 4 have been further diluted in the upper Austin, while in the middle Austin Wardner 34 is nearly enclosed by dry gas and Wardner 57 is unchanged. King 9 was recently completed in the middle Austin, and as was predicted, is in a dry-gas area.

Current and Cumulative Cycling Efficiency

The efficiency of operations may be checked at any time by use of the method of determining the amount of dry gas in the well effluent as also outlined by Lewis[2] which combines the foregoing method of estimating

$$\text{Per cent dilution} = 100 \times \frac{\text{(Av. orig. liquid content — retrograde loss) — Av. liquid content}}{\text{Av. original liquid content}}$$

As a check on the validity of the

TABLE 2—CUMULATIVE MAXIMUM LIQUID LOSS BY THEORETICAL DEPLETION OF RESERVOIR

Item—	Upper Austin	Middle Austin
Original C_{5+} in recoverable gas, (thousands of barrels)	2,447	1,811
Cumulative retrograde condensation, (thousands of barrels)	304	257
Cumulative retrograde loss, per cent of original C_{5+} (per cent)	12.4	14.2
Cumulative retrograde loss as B.t.u. (billions)	1,468	1,241

TABLE 1—LIQUID CONTENT (C_{5+}) DATA OF WELLS NOT OPERATED FOR A PERIOD

	Upper Austin					Middle Austin				
Well—	Date	G.p.m.	Date	G.p.m.	G.p.m. Diff.	Date	G.p.m.	Date	G.p.m.	G.p.m. Diff.
Wardner 24	7-1-44	.345	(*)	....	....	1-1-45	.370	(*)	....	....
Wardner 33	.....	....	.....	....	....	7-1-45	.110	(†)	....	....
Wardner 34	7-1-45	.825	1-11-48	.620	—.205	7-1-45	.580	1-1-48	.235	—.345
Wardner 37	7-1-44	.810	(*)	....	....	1-1-44	.855	(*)	....	....
Wardner 57	7-1-45	.555	1-11-48	.386	—.169	7-1-45	.780	1-1-48	.780	None
King 3	.....	....	.....	....	....	7-1-45	.210	(†)	....	....
King 4	7-1-44	.675	1-13-48	.497	—.178	.....	....	.....	....	....
King 9	.....	....	.....	....	....	Not drilled	....	1-1-48	.026	None

*Removed from sand. †Inoperative.

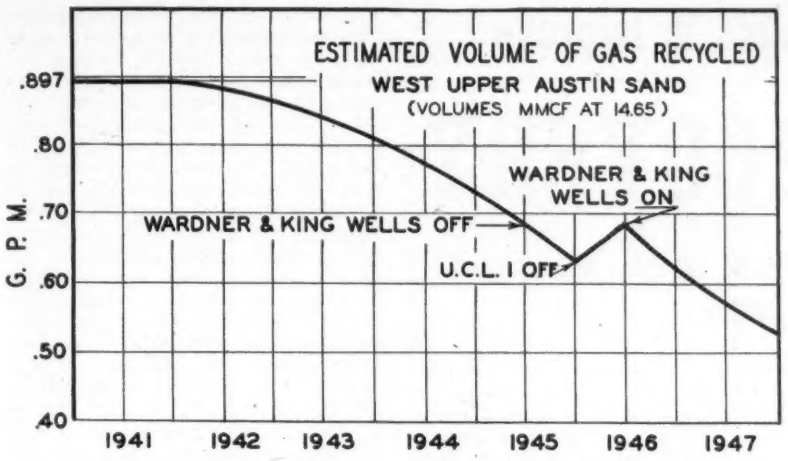


Fig. 5 (U)—Graphic and tabulated data for the upper Austin sand, by years

Year—	1941	1942	1943	1944	1945	1946	1947
Cumulative ratio	100	101.7	104.4	108.5	112.2	113.3	116.2
Cumulative dry gas	0	220	1,370	4,224	7,240	8,332	10,863
Cumulative wet gas	208	13,164	31,473	49,950	59,576	62,634	67,152
Cumulative total	208	13,384	32,843	54,174	66,816	70,966	78,015
Yearly dry gas	0	220	1,150	2,854	3,016	1,092	2,531
Yearly wet gas	208	12,956	18,309	18,477	9,626	3,058	4,518
Yearly total	208	13,176	19,459	21,331	12,642	4,150	7,049
Yearly per cent dry gas	0	1.7	5.9	13.4	23.9	26.3	35.9

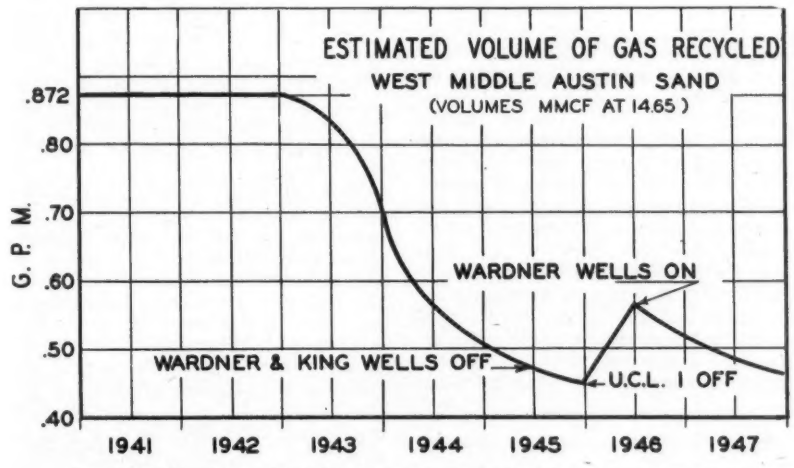


Fig. 5 (M)—Graphic and tabulated data for the middle Austin sand, by years

Year—	1941	1942	1943	1944	1945	1946	1947
Cumulative ratio	100	100	107.6	119.0	127.6	129.2	132.2
Cumulative dry gas	0	0	993	5,862	10,499	11,738	13,902
Cumulative wet gas	1,083	12,132	28,272	37,697	43,119	44,966	47,678
Cumulative total	1,083	13,215	29,265	43,559	53,618	56,704	61,580
Yearly dry gas	0	0	993	4,869	4,637	1,239	2,164
Yearly wet gas	1,083	12,132	15,057	9,425	5,422	1,847	2,712
Yearly total	1,083	12,132	16,050	14,294	10,059	3,086	4,876
Yearly per cent dry gas	0	0	6.2	34.1	46.1	40.1	44.4

the per cent dilution by operating wells or total operating wells and applying this percentage to actual produced volumes.

These data for the Austin sands are illustrated in Fig. 5 (U), Fig. 5 (M), and the accompanying tables. It is seen that dilution occurred in the upper Austin within the first 6 months of operations, when approximately 12.5 billion cubic feet had been produced. Well No. U.C.L. 1 was the first to show dry gas influx, which is obviously due to channeling through a relatively high permeable lens from Rivers A-2. By mid-1945, the net wet-gas production was equal to 52.0 per cent of the estimated original recoverable gas in place. Also, at this point the reservoir pressure was only 7.0 per cent below the dew point, which indicated an average loss of 0.014 g.p.m. from retrograde condensation.

The comparative data for the middle Austin show that first dilution occurred when some 14 billion cubic feet of wet gas had been produced. By mid-1945 net wet-gas production in this case was equivalent to 48.0 per cent of the estimated original recoverable reserves and the reservoir pressure, which was 9.4 per cent below dew point, indicated 0.034 g.p.m. loss due to retrograde condensation.

Decreased dilution in June 1946 is the result of closing in wells producing a large percentage of dry gas. Currently, although cycling has been discontinued, approximately 35.9 per cent of the gas produced from the upper sand is dry and 44.4 per cent of the production from the middle is dry.

Comparative Losses by Cycling

As a final analysis the theoretical loss of liquids, had these sands been depleted by direct voidage without reinjection, may be compared to the actual losses accrued to the end of cycling by reducing each to the common denominator of energy in B.t.u.

By combining pressure loss per unit of reservoir voidage and retrograde condensation data, the cumulative liquid loss may be computed. The retrograde data available have not been fractionated which, as described by McAllister,[3] provides an erroneous conclusion since at the higher pressures the lighter hydrocarbons, which would become vapor at abandonment pressure, are in solution. In order to give every benefit to the liquid loss, it has been assumed, for purposes of this comparison, that there would be no enrichment of the injected dry gas by absorption and that the mechanical sweep is negligible. The result of this computation is summarized in Table 2.

The cycling losses are chargeable directly in cubic feet of gas used for fuel and miscellaneous requirements for both reprocessing and compression. In reservoirs of this type, direct dry-gas sales to pipe line are precluded due to the small sand lenses which cannot be swept by dry gas and will, as a consequence, enrich the dry-injected gas on back flow. This permits assumption that all dry gas produced will require complete processing, thereby subjecting all injected dry gas to at least one additional process loss. The dry gas produced with the wet gas during cycling loses both from processing and compression on the recycle.

From a plant balance it has been determined that the processing loss amounts to 2.89 per cent of the total plant input and that compression accounts for an additional 1.62 per cent for a total of 4.51 per cent processing and compression loss.

(Continued on page 191)

Modern Process Methods to Improve L. P. G. RECOVERY

*by G. W, McCullough, * K. H. Hackmuth, * and A. J. Miller**

REQUISITE of the early absorption-oil-type gasoline plants was to extract the pentanes-plus fraction with enough butanes to make a 26-lb. product. During the summer months even these butanes were often fractionated off to the plant flare or other distress disposal when the only salable product was a 12-lb. butane-free gasoline.

Although there was then but small incentive to study methods for increasing the propane-butanes extraction, the ingenuity of the gasoline-plant designer was taxed to provide a minimum-cost, low-operating expense plant that would yield a fair payout under the natural-gasoline prices that existed in the early 1930's. Phase-equilibrium constants or, more properly, ratios and the absorption factor equation came into widespread use about this time and provided a valuable tool for evaluating the factors influencing absorption.[1,2,3] The contributors to this knowledge are many and the data and excellent articles published are too voluminous to mention here.

Under today's market conditions and apparent insatiable demand for liquefied petroleum gas products, the knowledge gained during the earlier but leaner years is being utilized to the utmost to revamp existing plants for increased extraction and to design new plants for almost complete propane extraction or to the maximum allowed by contractual B.t.u. limitations on the residue gas. The factors influencing absorber performance are now well known but will be briefly reviewed:

1. **Absorber pressure.**—The older low-pressure plants, operating on rather rich gas compressed from subatmosphere to the range of 40 to 50 psi. pressure, can now usually pay out additional compressors and higher-working-pressure absorbers if the gas reserves are adequate for several more years. In the more modern plants the absorber pressure is sometimes higher than the economical optimum for extraction because of pressure maintenance or other residue-gas requirements. In design of new plants, the economics of increasing absorber pressure must be compared with other methods of increasing extraction as there is usually an optimum pressure above which the increased extraction may be obtained more economically by other methods.

2. **Absorption temperature.** — The importance of this factor cannot be overemphasized; it affords a means of increasing extraction in many existing plants by adding more lean oil coils or by supplementing water cooling of the oil with propane refrigeration. An important advantage of the lower absorption temperature is that the heavier constituents are selectively absorbed over the lighter gases. This is an important consideration since the ethane, methane, hydrogen sulfide, and possibly inert gases are detrimental when absorbed in the rich oil and require additional equipment for their elimination. Frequently, increasing extraction of propane-butanes in the absorber fails to net an increase of plant product in the storage tank because the increased extraction of lighter constituents prevents their condensation and recovery.

Additional cooling may be applied directly to the lean oil to the absorber or by using an intercooler to cool the oil a few trays below the top. Lowering the temperature of the lean oil to the top of the absorber results in a lower residue-gas temperature, which in turn lowers the moisture content of the residue gas. This may be beneficial in reducing moisture condensation in a pipe line or the load on a gas dehydrator. As approximately a 20° F. reduction in residue-gas temperature would halve the moisture content, the investment and operating expense of a gas dehydrator would be substantially lower.

When it is not beneficial to lower the residue gas temperature, the intercooler method is more efficient than refrigerating the lean oil as it directs most of the cooling to lowering the effective absorption temperature with less loss of refrigeration to the residue gas. Where there is considerable methane absorption, most of the absorption-oil temperature rise occurs near the top of the absorber. The intercooler then removes this heat of absorption and the effective absorption temperature of the oil is benefited by almost the entire amount of refrigeration.

3. **Lean-oil molecular weight.**—According to the absorption equation, a decrease in lean-oil molecular weight results in a proportionate increase in the absorption coefficient but similarly results in a lowering of the stripping coefficient. Between these two factors and other considerations such as oil entrainment, oil retrograde losses, and cost of available absorption oil, the optimum molecular weight oil must be determined. In order to maintain optimum molecular weight, an efficient oil reclaimer is a "must" in present-day plants.

4. **Absorber trays.** — Like lean-oil cooling, increasing the number of absorber trays provides a method of selectively increasing the extraction of

*Phillips Petroleum Co., Bartlesville, Okla.
A paper presented at the twenty-seventh annual convention, Natural Gasoline Association of America, Texas Hotel, Fort Worth, March 24-26.

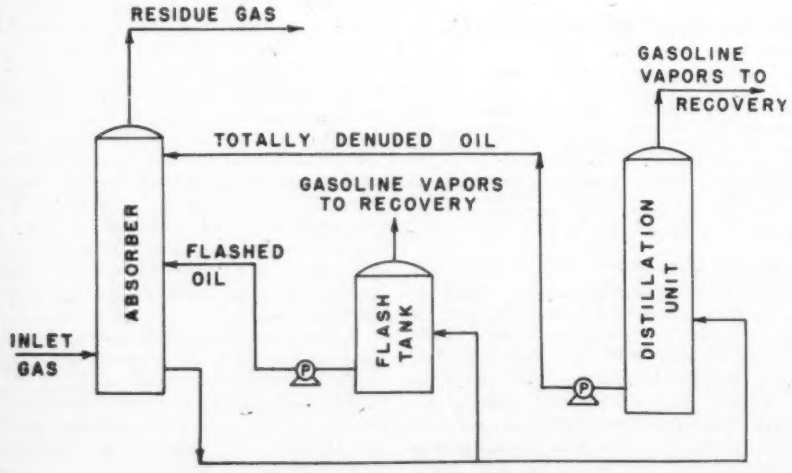


Fig. 1—Flash-flood system, simplified flow sheet

desirable constituents over the lighter gases. Many of the older plants are now finding it profitable to increase the number of trays for extraction of more propane and butanes. It is important to provide the optimum number of trays because trays once installed do their work with negligible operating expense.

5. **Lean-oil rate.**—Most of the other factors mentioned allow a significant but limited increase in extraction while oil rate provides a means of increasing extraction limited only by economics. Every gallon of lean oil circulated requires horsepower for pumping, steam for stripping, and equipment for heating and cooling. It is a costly item and every advantage should be taken to reduce it if economical high propane extraction is to be attained.

The characteristics of absorption of any component, as shown by the absorption factor curves, display diminishing returns of increase in extraction for increase in oil rate as the extraction percentage becomes higher. For this reason, the increment of oil rate required to increase propane extraction, say from 60 to 90 per cent, results in a greater than proportionate increase in ethane and methane extraction.

The absorption coefficient for hydrogen sulfide has been found to fall between the values for propane and ethane. Hence, in areas where the absorber inlet gas is sour, the deep extraction of propane results in high absorption of undesirable hydrogen sulfide. For successful retention of the heavy constituents, the reduction of ethane and lighter with hydrogen sulfide—if present—must be accomplished.

Multiple Absorption Methods

One of the major investment and operating costs of a gasoline plant is that required for equipment to properly strip and cool the lean oil. For absorption of all the pentanes-plus fraction, it is of course necessary that the lean oil be almost completely stripped of pentanes. However, when a gasoline plant is designed for very high propane extraction, the increment of oil required for extraction of propane and butanes is significantly larger than that required for absorption of the pentanes. The principle of multiple absorption is to provide enough completely stripped lean oil to the top of the absorber for absorption of the pentanes and apply at a point lower down in the absorber a larger volume of partially denuded oil for the desired absorption of propane-butanes.[4,5,6,7] A simplified flow sheet is shown in Fig. 1, illustrating this principle.

This type of multiple absorption has been termed flash flood since the oil required for high absorption of the liquefied petroleum gases is circulated at a high rate to the midsection of the absorber and is partially denuded by cold flashing rather than by steam stripping. Thus the investment for steam stripping and for heating and cooling of the flashed oil is saved. In designing a plant of this type, there are many variables that must be evaluated. The rich oil to the flash tanks may be flashed in any desired number of stages so that the leaner vapors may be segregated for appropriate processing while the major part of the propane and butanes may be flashed off under vacuum and condensed. The number of stages of flashing, the flashing pressures, and the ratio of flashed oil to lean oil are the major variables to be examined.

The curves in Fig. 2 show the percentages of hydrocarbon constituents absorbed at varying flashed oil to lean oil ratios at an absorption pressure of 250 psig. Also shown are the compressor horsepower requirements for handling the flashed vapors and for circulating the absorption oil.

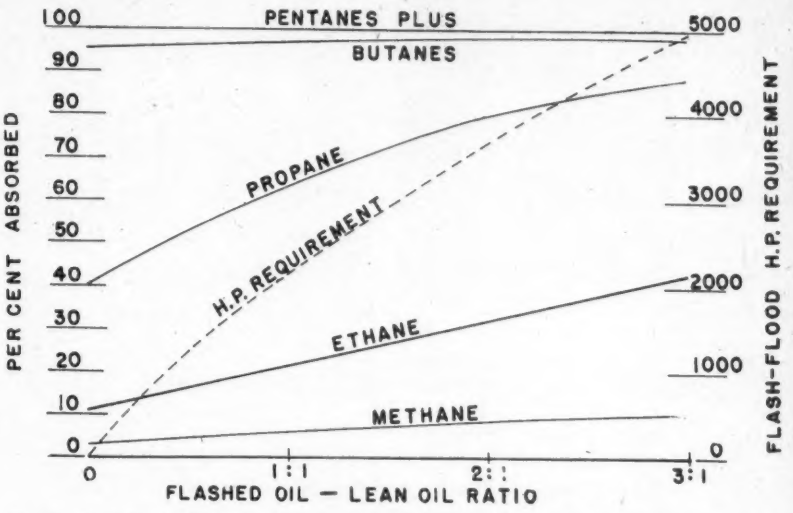


Fig. 2—Flash-flood absorption characteristics; lean oil rate is 2,300,000 gal. per day, inlet gas rate 140,000,000 standard cubic feet per day, and pressure 250 psig.

In order to attain the desired removal of propane and butanes without heating the flashed oil, it is necessary to operate the final flash tank under vacuum. This makes possible air leakage into the system, which may introduce a serious corrosion problem in sour-gas areas. This contingency may be circumvented by accomplishing the partial denudation with steam stripping instead of cold flashing. The total rich oil from the base of the absorber passes through appropriate vent tanks and heat ex-

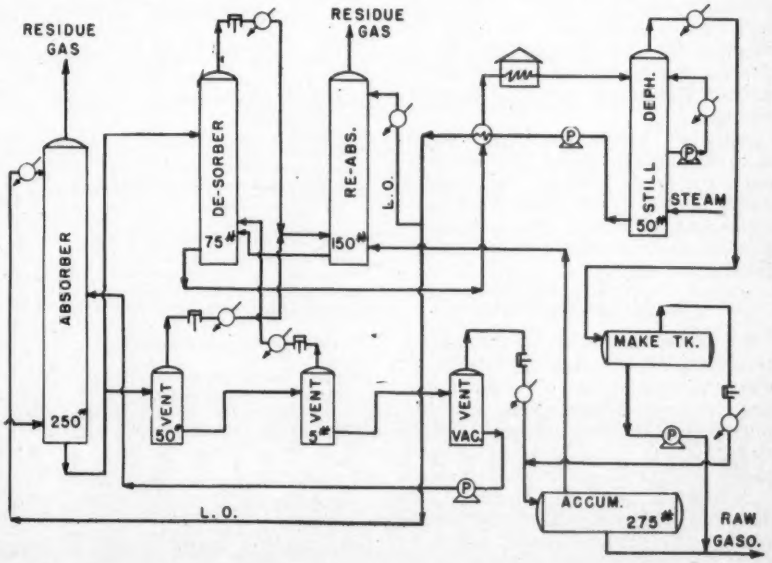


Fig. 3—Flash-flood plant with desorber, no residue limitations on extraction

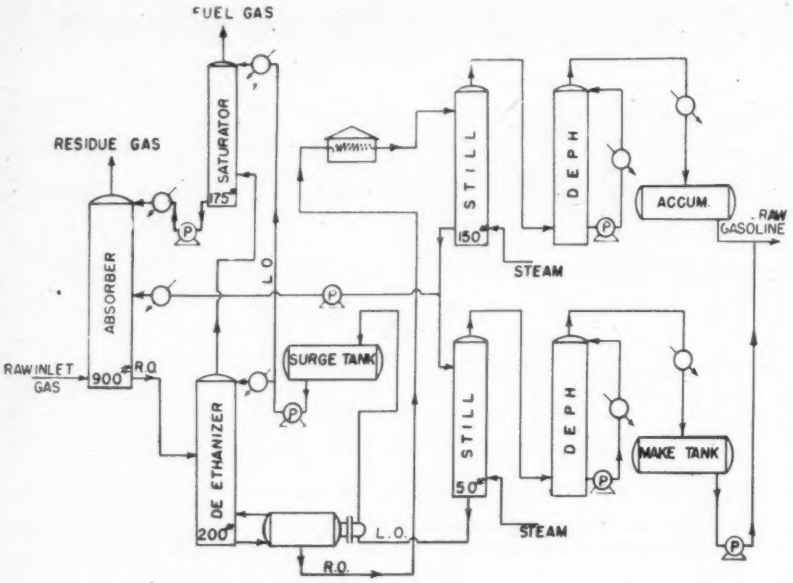


Fig. 4—Flow diagram of high-pressure plant, residue limitations on extraction

changers and a furnace preheater to the preliminary still where enough steam is used to strip out a substantial portion of the butanes and nearly all of the propane and lighter components. The partially denuded oil leaving the bottom of the preliminary still divides into two streams, the major portion passing through cooling coils to the lower section of the absorber, while the other stream—only the quantity required for pentanes-plus absorption—passes to the final still for total denudation.

The investment and operating savings attainable with the partial steam stripping system are not usually as large as with the flash-flood system because the partially stripped oil requires heating and cooling. The savings of this system over straight absorption for equivalent extraction are due to the reduced stripping steam and dephlegmator cooling requirements.

Although the purpose of this paper is to discuss processing for high propane recovery, it should be pointed out while discussing flash-flood multiple absorption that this system offers excellent possibilities for ethane recovery if desired.

Light-Gas Removal

The deep absorption of propane is accompanied by high quantities of methane and ethane, the amount depending upon whether high-pressure, high-oil-rate, refrigeration, multiple absorption, or a combination of these methods is used. Although the light-end quantity may be somewhat reduced by advantageous use of refrigeration and absorber trays, even the best selection of variables will ordinarily result in light-end absorption too great for the simple venting methods utilizing pressure reduction and heating of the rich oil, as they would result in high recycle, recompression, and reabsorption costs.

Flash drums afford only a single-plate or equilibrium-flash separation, which may be considerably improved by using bubble-plate separation methods to supplement or supplant the single-plate flashings. This is analogous to using a bubble-plate fractionator to stabilize raw product instead of a weathering process. The means that the modern designer has devised for more economical separation and recovery of propane-butanes in the light gases are, basically, the use of bubble-plate separations instead of single flashing and include:

1. Rich oil deethanization.[8]
2. Two-stage rich oil stripping at high and low pressure.[9]
3. Rich-oil desorption.[10 11 12 13]
4. Lean-oil presaturation.

Rich-oil deethanization is fractionation of the rich oil from the absorbers to eliminate the ethane and lighter. The rich oil from the absorber enters the lower section of a two-section bubble-plate column. The bottom is the stripping section containing a reboiler; the upper section recovers propane and heavier stripped out in the lower section by lean oil absorption. This process was recently described in a published article by A. M. Whistler,[8] whose studies indicated this process to be limited to relatively rich gases and for moderate propane recoveries. Recoveries of much higher than 70 per cent of the propane in the rich oil are not economical because of the high volume of lean oil required over the top section.

The principle of two-stage stripping is widely applicable to rich oils containing large quantities of light ends as it affords a means of eliminating or greatly reducing costly recompression. The first still should operate at a pressure higher than the reabsorber so that the noncondensable vapors from the overhead coolers may flow to the reabsorber without recompression. Enough steam should be used in the first still so that the overhead vapors from the final still totally condense at the operating temperature and pressure. Although the optimum operating pressures for the two stills depends on the absorber pressure,

(Continued on page 196)

TABLE 1—COMPARISON OF STRAIGHT AND MULTIPLE ABSORPTION SYSTEMS PROCESSING 140,000,000 STANDARD CUBIC FEET PER DAY OF INLET GAS

	Straight absorption		Multiple absorption	
			Flash flood	Partial stripping
Absorption pressure, psig.	250	600	250	250
Per cent absorbed:				
Propane	80	80	80	80
Butanes	99+	99+	98	99+
Pentanes-plus	99+	99+	99+	99+
Absorption oil circulation—gal./day				
Totally denuded oil	6,350,000	3,000,000	3,500,000	3,150,000
Partially denuded oil	.....	.....	4,600,000	3,500,000
Compressor horsepower for boosting inlet gas above 250 psi.	.....	7,400	.....	.....
Compressor hp. for vapor handling	.....	.....	2,800	.....
Pump hp. for totally denuded oil	1,200	980	660	600
Pump hp. for partially denuded oil	.....	.....	900	660
Total variable horsepower	1,200	8,380	4,360	1,260
Stripping steam requirements, lb./hr.	92,500	43,800	51,000	61,000
Oil-cooling requirements, B.t.u./hr.	75,700,000	35,770,000	41,730,000	79,290,000
Oil-heating requirements, B.t.u./hr.	177,000,000	104,500,000	115,800,000	183,500,000
Dephlegmator-cooling requirements, B.t.u./hr.	111,480,000	73,300,000	78,960,000	82,940,000
Relative investment for variable process equipment	1.47	1.06	1.00	1.40
Annual operating expense (less gas royalty and indirect expenses)	$383,000	$496,000	$420,000	$363,000
Relative operating expense to flash-flood	0.91	1.18	1.00	0.87

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Entirely aside from its remarkable fuel economy, the Turboflow development obviously offers other great savings. With its greater power-to-space ratio, the over-all cost of installation per horsepower is far less! Since it takes fewer engines and actually *less* space to meet total power needs, the cost per horsepower of personnel, maintenance, part replacement and general overhead is correspondingly lowered! Furthermore, the Turboflow principle reduces *heat dissipation both to water and lube oil*, so that cooling towers, radiators or heat exchangers need have no greater capacity than for old style, less powerful engines.

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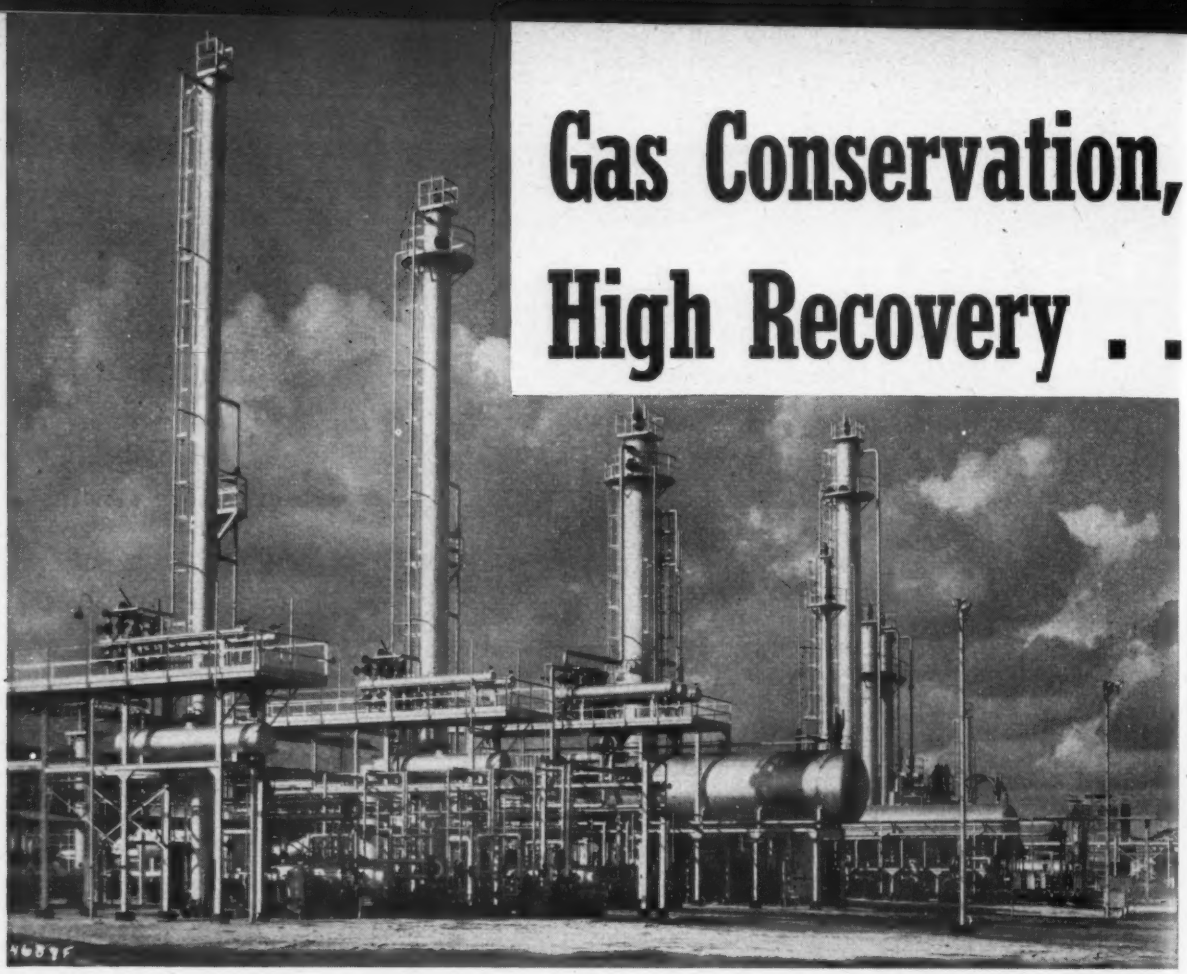


Magnolia Petroleum Co.'s new Vanderbilt gasoline plant, located in the Lower Texas Gulf Coast, maintains an average current throughput of about 25 M.M.c.f. of casing-head gas and over 40 M.M.c.f. of high-pressure field gas from West Ranch field of Jackson County. The plant produces kerosine, natural gasoline, and L.P.G., and all surplus residue gas is moved to the company's Beaumont refinery, 196 miles distant, where it is utilized as fuel

Provided by Magnolia Petroleum's Vanderbilt Plant

by George Weber

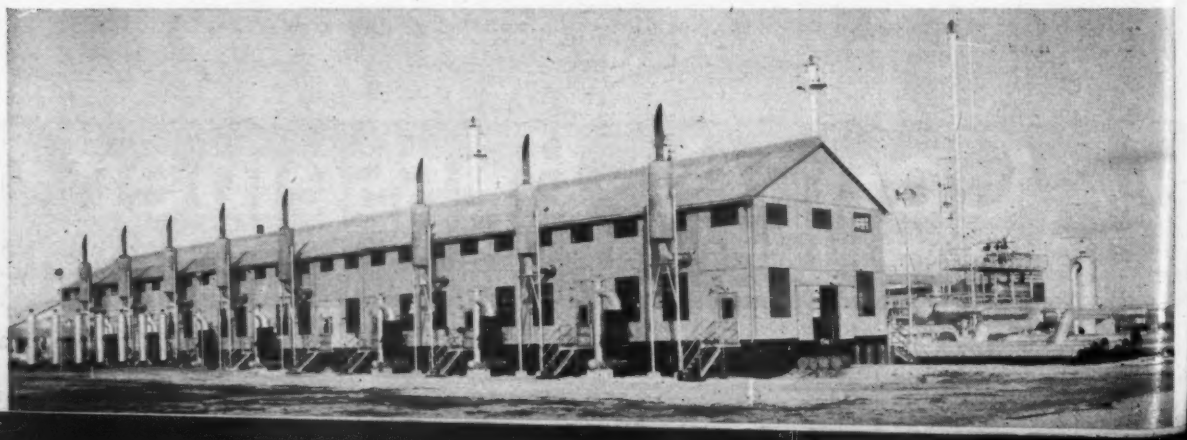
CURRENT trends toward greater utilization of casing-head gas and increased recovery of liquefied petroleum gases are well illustrated in Magnolia Petroleum Co.'s new gasoline plant at Vanderbilt, Tex. Serving West Ranch field in Jackson County, the plant processes both casing-head and high-pressure gas. It is designed

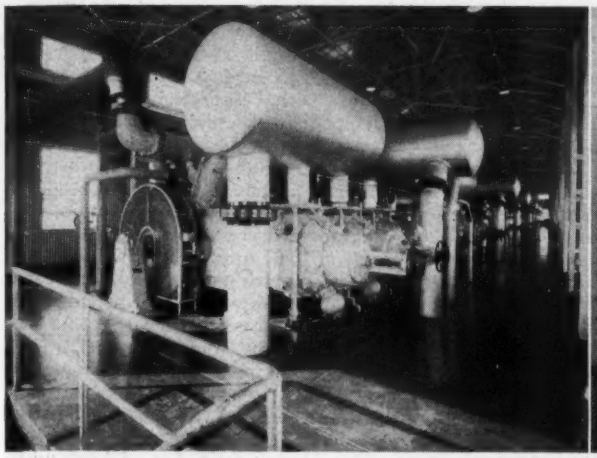
New Gasoline Plants—Here one of the Journal's Texas district editors describes the equipment and processing used by Magnolia in their new West Ranch plant. Views taken by the Journal's staff photographer, R. B. Ward, cover various important features.

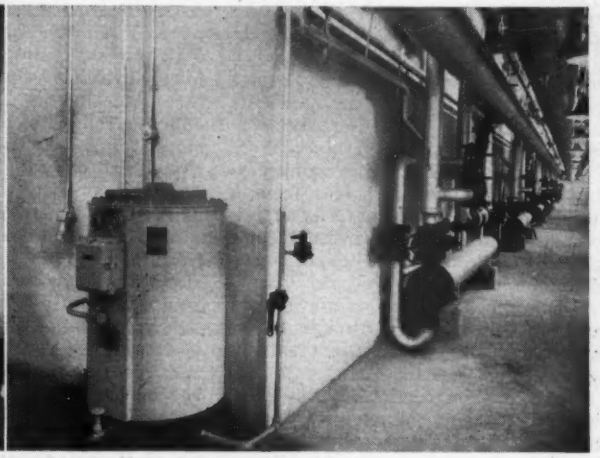
to handle a daily throughput of 60 million cubic feet of high-pressure gas and 27.5 million cubic feet of casing head through separate absorption systems.

Originally, the over-all plan called for the use of some high-pressure residue gas for injection to the oil-producing Greta sand in the field.

Casing-head gas from atmospheric separators in the field reaches the plant at a 10-in. mercury vacuum. Its final compression to 1,000 psi. for pipe-line delivery requires compressors totaling 8,460 hp.







Left: These eight new 1,000-hp. Cooper-Bessemer, two-cycle, V-type gas engine-compressor units each have five compressor cylinders. Two compressor cylinders handle the first compression stage of casing-head gas. All gas is cooled and scrubbed between stages. Gas discharged from the third stage at 325 psi. is moved after chilling to the processing section of the plant, and only residue gas is compressed to the final 1,000-psi. stage. Large-volume tanks are installed on inlet and discharge lines of all four stages to damp vibration. All inlet tanks of which the first and stage vessels are visible here, are located above the compressors, and those on discharge lines are installed in the basement. Right: The multiplicity of intake and discharge lines and capacity vessels for the plant required the construction of two basement sections flanking the compressor foundation blocks. This view of one of the basement sections shows oil coolers and overhead lines carrying engine-circulating water. In the foreground is a lubricating-oil filter being used experimentally. Gas lead lines and discharge vessels are located on the opposite side of the compressor foundation

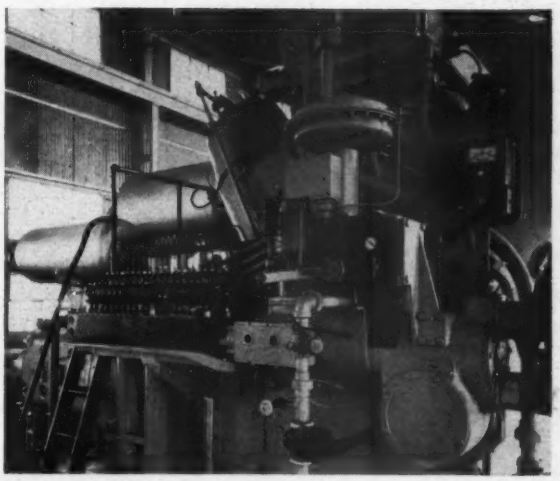
REPRESENTATIVE ANALYSES OF GAS PROCESSED IN MAGNOLIA VANDERBILT GASOLINE PLANT

	Mol % hp. gas*	CH gas
Methane	95.85	90.33
Ethane	2.79	4.36
Propane	0.56	2.54
Isobutane	0.25	0.70
n-Butane	0.13	0.63
Isopentane	0.09	0.40
n-Pentane	0.05	0.25
Hexanes+	0.28	0.79

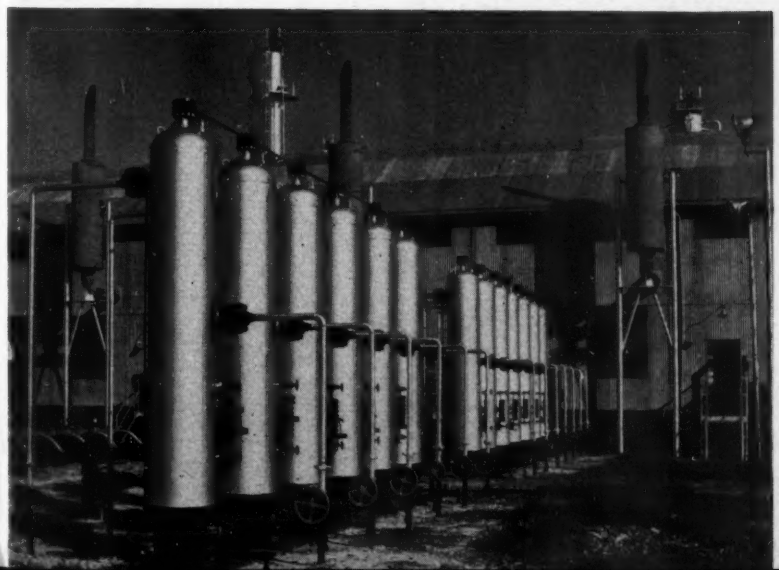
*Composite of samples from Marginulina and Menefee gas reservoirs.

However, subsequent reservoir data have revealed that a sufficient water drive exists in that sand, and repressuring or pressure maintenance with further gas return is considered unnecessary. As a result all residue gas excepting a small fraction returned to the field for lease use is charged to a 196-mile pipe line to be utilized as fuel in the company's Beaumont refinery.

This Hammel-Dahl control, mounted on each compressor, governs its speed within limits. At full compressor load, the control actuates butterfly valves in the two main casing-head gas intake lines serving the north and south sections of the field, maintaining a constant selected intake pressure. Unloaders shown on compressor cylinders in photograph at left, above, add to their flexibility of operation



All casing-head gas produced in the field and formerly flared, is now charged to the plant. Most leases are equipped with heater-treaters and all field separators operate at or near atmospheric pressure, yielding a rela-



High-pressure gas production from 13 wells in West Ranch field is charged to this bank of separators where distillate is removed before gas is introduced to twin high-pressure absorbers. These separators were installed before the plant was built, and those nearest the compressor building will be moved away from compressor air intake points

tively rich raw gas. High-pressure gas is withdrawn as required to meet pipe-line gas demand. Although very lean as compared with the casing-head gas, this gas well production is also processed, in two absorbers operating at 1,000 psi.

The necessity for compressing casing-head gas in four stages from a 10-in. mercury vacuum to 1,000 psi. demanded a large investment in compressor equipment, considered justifiable in the interest of gas conservation. Otherwise the plant is conventional in design, although it incorporates some important features which improve efficiency.

Prior to construction of the gasoline plant, the company operated a small compressor plant which utilized some gas for injection to the oil reservoir. A gas pipe-line dehydration unit was also operating in the field before the plant was installed. As an economy measure, equipment from these installations was incorporated into the new plant.

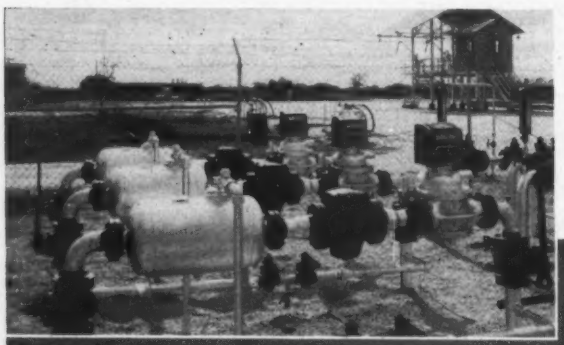
Compressor investment was reduced by processing casing-head gas at an intermediate pressure. On discharge from the third compression stage, the gas is chilled to 50° F. and charged directly to the low-pressure absorber at 325 psi. Utilization of chilling equipment on hand from the former dehydration unit provided efficient absorption at a lower lean-oil circulation rate. Plant fuel requirements are withdrawn from the residue gas stream before the remainder is compressed in the final stage to 1,000 psi. for pipe-line delivery. This reduced the final compression load by about 500 hp. and utilization of two 230-hp. compressor units converted from the former injection unit, saved investment in an additional 1,000-hp. compressor.

In the processing section of the plant, rich oil is conditioned and butane and propane recoveries maintained with lower lean-oil circulation rates, through use of the propanizer reabsorber. In that column, rich oil from both absorption systems is stripped with uncondensed vapors from the raw product feed tank, or still accumulator. These vapors, rich in propane and butanes, replace undesirable methane in oil solution, the lighter hydrocarbons passing overhead to fuel lines. The cycle is automatic, requiring no instrument control, since the volume of uncondensed vapors passing overhead from the still determines the amount of stripping taking place in the propanizer reabsorber.

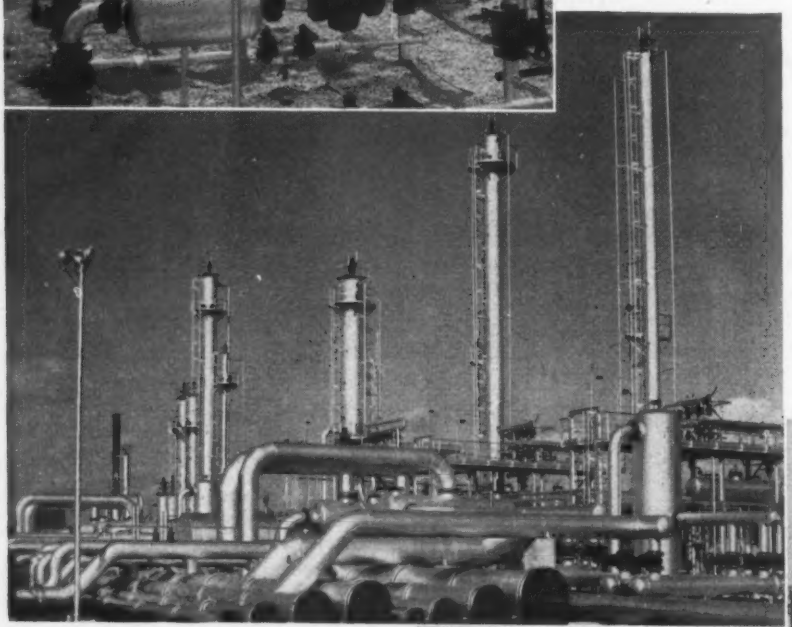
Savings in fuel required by the rich oil heater are realized by flashing rich oil after exchange of heat with lean oil from the still bottoms. Vapors withdrawn from the rich-oil flash tank are then charged directly to the still and rectifier, bypassing the heater.

Process efficiency in the new plant is well illustrated by production figures. During the past 4 months, the plant has averaged daily, an input of 25 million cubic feet of casing-head gas and 40.5 million cubic feet of high-pressure gas. Production has averaged 1,250 gal. of kerosine, 24,200

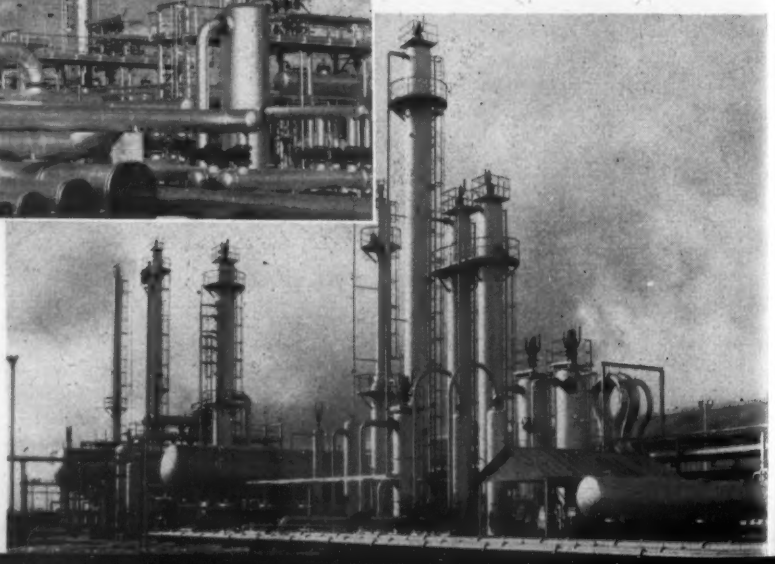
(Continued on page 196)



Left: Product lines for natural gasoline and L.P.G. are equipped with A. O. Smith positive displacement meters. Loading rack for truck shipments is located in the background.



Below: The absorber section in the foreground includes two 1,000-psi. absorbers for gas-well production, the casing-head gas absorber operating at 325 psi., and the propanizer reabsorber column. To the left are the still and two fractionation columns. Kerosine is withdrawn from the side of the still and rectifier. The fractionation section is designed with sufficient flexibility to allow production of all commercial combinations of natural gasoline and L.P.G. A third fractionator is to be added to the plant to provide for separation of commercial propane. In the immediate foreground, to the right, is the dehydration section where all residue gas is contacted with diethylene glycol before delivery to the pipe line



Above: The banks of discharge and intake headers (left and right) serving the compressors are installed on concrete piers easily accessible for operation, maintenance, and inspection. The low-pressure intake header feeding the first compression stage (extreme right) measures 42 in. in diameter, believed the largest of its kind for a plant of this size.

More Propane for Less Money

by Z. C. Ambrose*

Southwest Gas Producing Co., Inc., has joined forces with W. C. Feazel, Shreveport oil man, to build a plant to process gas from their joint holdings in Hico field near Dubach, Lincoln Parish, Louisiana. This plant represents one of the most interesting departures from conventional high-pressure gasoline-plant design since the cycling industry began.

IN the early days of the natural-gasoline industry, everything that could be recovered from natural gas and held in pressure storage, even at low temperatures, was considered and marketed as natural gasoline. As production increased, certain restrictions were imposed upon the product, such as vapor pressure and specific gravity. In the early 1920's, a major step was made toward stabilization of the product, the first stabilibers being those designed and constructed by Carbide & Carbon Chemicals Corp. under the Rafferty patents. Shortly following this, the high-pressure stabilizer which is now in common use was developed. In these early stabilizers, most of the propane and considerable quantities of the butanes were eliminated from the raw plant production, leaving a natural gasoline having a Reid vapor pressure of 12 to 26 lb.

For a number of years, the demand and price for the product did not warrant building plants to produce any more propane and butane than that which was recovered incidentally in the extraction of natural gasoline. As the liquefied petroleum gas industry developed, plants were built for a higher propane recovery and, in a number of cases, old plants were remodeled to give better extraction efficiency.

The war brought the first really great demand for propane and butane. Butane was used in the production of alkylate and propane was cracked and used in the production of synthetic chemical products. The chemical industry, largely built up during the war, is at the present time demanding greater and greater quantities of butane and propane.

This discussion concerns particularly a method for increasing propane recovery in high-pressure plants operating in gas-distillate fields.

Whenever possible, process engineers use a light, low-molecular-weight absorption oil because it increases extraction efficiency per gallon of oil circulated and decreases costs. Installation and operation costs are lowered because the quantities of liquids handled, whether from rich gas or absorption oil, has more to do with sizing a plant than the volume of gas processed. As the oil circulation is increased, pumping costs, heat loads, and sizes of all vessels and other equipment are also increased. Until recently, high-pressure gasoline plants were not afforded the benefits to be derived from using a low-molecular-weight oil because of retrograde evaporation. At high pressures, the light oil tends to revert to a gaseous state.

Lake Creek Plant of Superior

In recent years, experimental changes in plant design have been carried out at Superior Oil Co.'s cycling plant in Lake Creek field near Conroe, Tex.

This work, under the direction of S. F. Magor and R. A. Daugherty of Superior, appears to have pointed the way to a process whereby a low-molecular-weight absorption oil may be used in high-pressure plants. The actual process design work of the Lake Creek plant was handled by A. J. L. Hutchinson, who was at that time head of the process depart-

(Continued on page 200)

*Southwest Gas Producing Co., Inc. Paper presented at N.G.A.A. convention, March 24-26, Fort Worth.

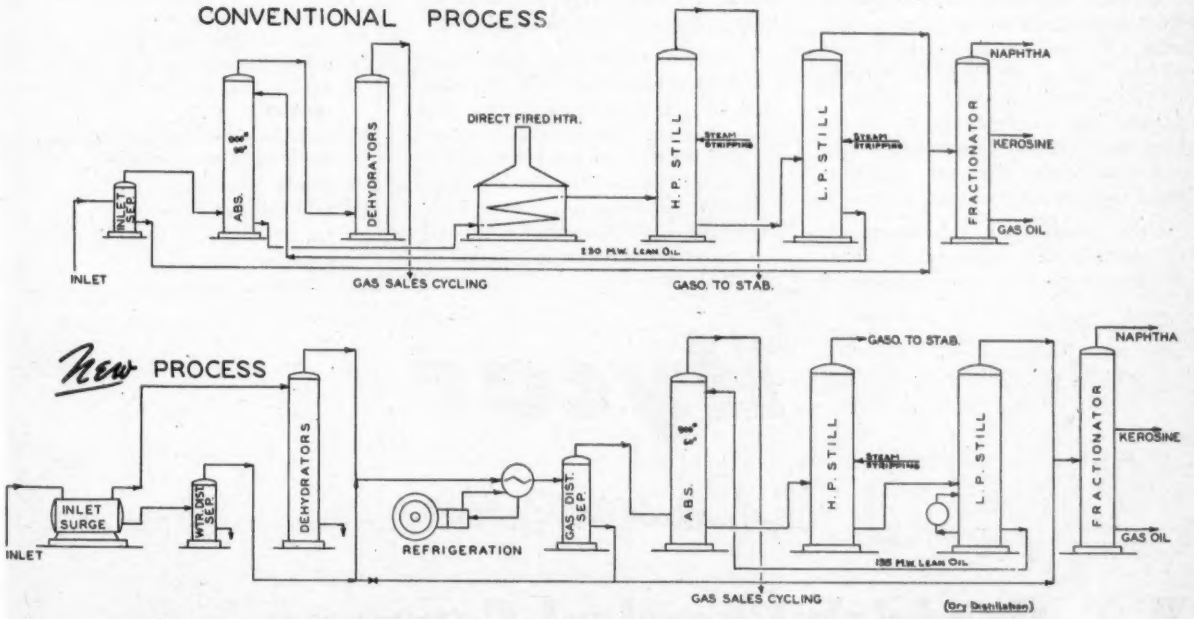


Fig. 1—Flow diagrams comparing the new processing discussed by the author, with conventional procedure

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Natural-Gasoline, Cycling-Plant Production May Reach 17 Million Gallons Daily

by John C. Casper

FOR the first time in history, monthly production at natural-gasoline and cycling plants has passed the half-billion-gallon mark. This record of 516,891,000 gal., set in December, rounded out a full year in which the production in every month was well above the output in the corresponding month in 1946. In January 1947 the total production averaged about 900,000 gal. per day more than in the previous January, but by the end of the year the pace had been stepped up until the daily average was 2,420,000 gal. more than in December 1946.

The unusually high production in the last few months of the year brought the 1947 total up to 5,544,044,000 gal. and kept unbroken a record of annual increases that has existed since 1934. This all-time high for 1947 compares with a total production of 4,861,033,000 gal. in 1946 which was also a record at that time. This gain of more than 683 million gallons represents an increase of 14.1 per cent.

A product breakdown of the total and a comparison with last year shows that the output of 2,743,837,000 gal. of natural gasoline represented 49.5 per cent of the total in 1947 compared with production of 2,691,001,000 gal. or 55.3 per cent of all light hydrocarbons in 1946. The actual volume increase in production was almost 53 million gallons but only 2 per cent above the total for the year before. Liquefied petroleum gases accounted for 34.1 per cent of the total production in 1947 and amounted to 1,889,524,000 gal. This was 34.1 per cent or 480 million gallons more than in 1946. The output of 910,683,000 gal. of miscellaneous products made up the remaining 16.4 per cent of the 1947 production at natural-gasoline and cycling plants, and represented a gain of 19.7 per cent over 1946.

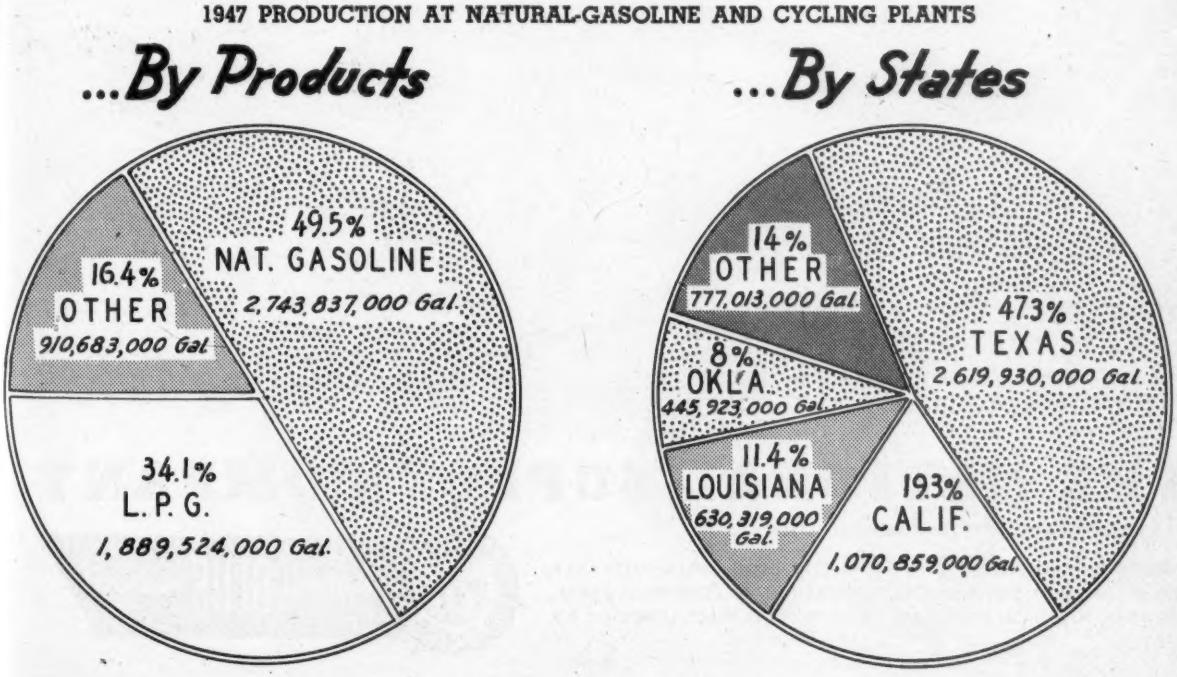
Record by States

A look at the record by states indicates that about 86 per cent of all light hydrocarbons was produced in four states. Texas led the list with an output of over 2.6 billion gallons for 47.3 per cent of the total. California's contribution of almost 1.1 billion gallons represented 19.3 per cent of all production. The Louisiana total was slightly over 630 million gallons for 11.4 per cent and Oklahoma produced almost 446 million for 8 per cent.

About 70 per cent of the total gain over 1946 is attributable to the increased production of L.P.G. This production total includes only the output at natural-gasoline and cycling plants and does not take into account the production of liquefied gases at refineries operating on crude petroleum. It is worthy of note that most of the increased production went directly into sales for fuel and chemical uses, while shipments to refineries had only a small percentage gain. The actual increases were 38.2 per cent on fuel and chemical sales and 6.9 per cent on shipments to refineries, indicating that the extra production has been moving toward the higher profit uses.

According to the reports of the Bureau of Mines, a total of 1,480,469,000 gal. of L.P.G. was delivered from natural-gasoline and cycling plants for fuel and chemical uses in 1947. In

1947 PRODUCTION AT NATURAL-GASOLINE AND CYCLING PLANTS



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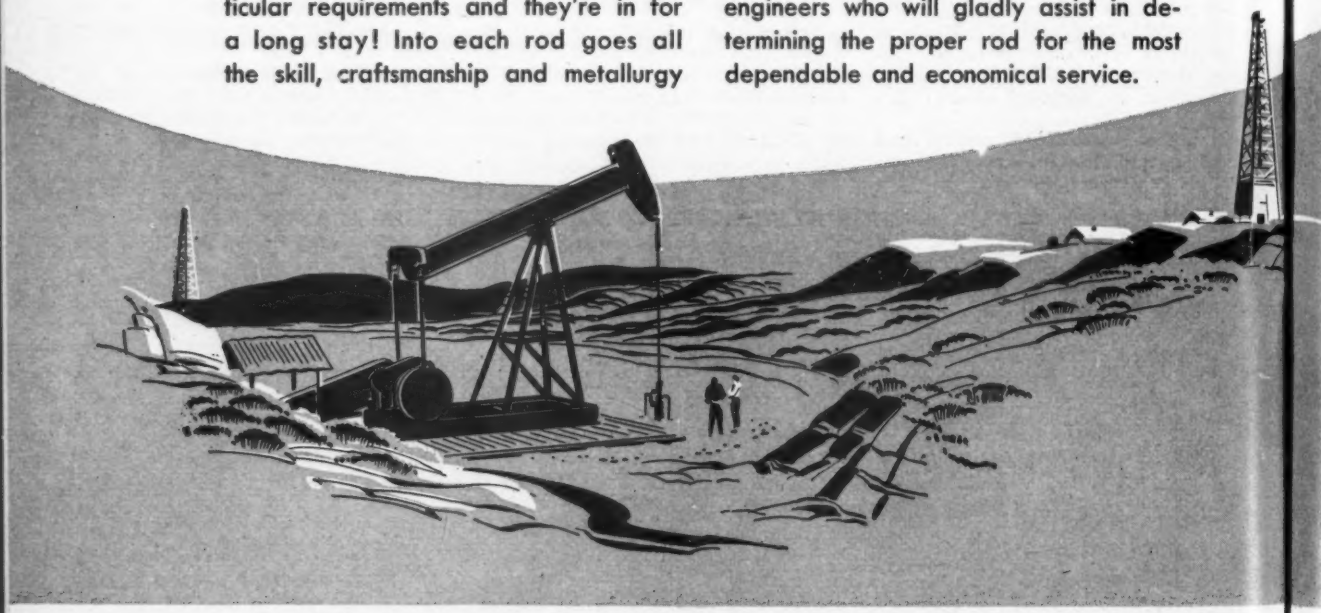

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ETE LINE OF OIL FIELD EQUIPMENT ★ FOR PRODUCTION

addition to this crude petroleum refineries made 784,140,000 gal. of liquefied gases for the same purpose. In other words, the natural and cycling plants supplied almost two-thirds of the fuel and chemical demand for liquefied petroleum gases in 1947. The refinery portion was up 20.9 per cent over 1946 compared with the 38.2 per cent increase from natural and cycling plants.

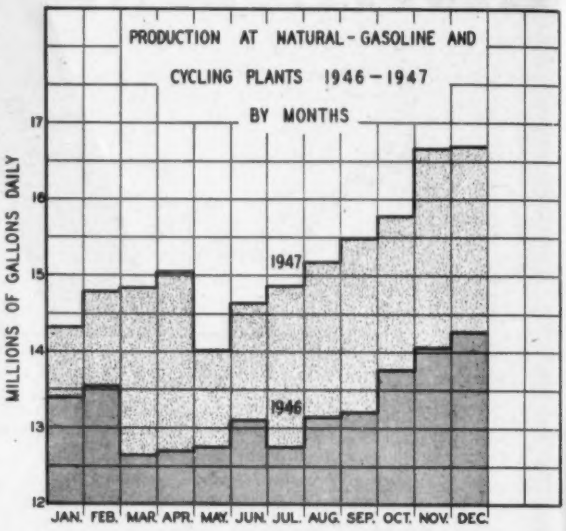
The percentage gain in the output and use of liquefied gases in 1947 topped the list of outstanding increases recorded for the petroleum industry. Crude production was up 7 per cent. Total demand for gasoline increased by 7.8 per cent. Total demand for distillate fuel oil jumped 20.5 per cent. Compared with these important gains, the production of L.P.G. at natural-gasoline and cycling plants was 34.1 per cent above production in 1946.

Production of natural gasoline over the past years has been influenced to a marked degree by the varying prices that have been paid for the product. The spot price for grade 26-70, Mid-Continent natural gasoline reached an all-time low of 1½ cents per gallon in June 1940. This was less than one-third of the prevailing spot price for regular-grade gasoline in the same area. While these rock-bottom quotations did not last but a few months, the price remained relatively low throughout the war period. In the early postwar period before the high civilian demand for motor gasoline became apparent, the general picture was that the capacity to produce natural gasoline was greater than the potential demand. As the stocks built up prices dropped until the Mid-Continent spot price reached 2¼ cents per gallon at the end of February 1946. Prices started to climb again along with the increase in the demand for gasoline, and before the end of the year the spot price was up to 5 cents per gallon. Several increases were posted in 1947 and at the end of December quotations were at 8½ cents per gallon. These more normal prices for natural gasoline should be an incentive for capacity production in 1948 and the total for the year should represent a gain greater than the 2 per cent increase in 1947.

The outlook for 1948 includes higher potential demands for all products in the light-hydrocarbon group. In addition to the increase for natural gasoline, the continuing growth in the demand for L.P.G. will bring another record year in the output of liquefied gases. However, the gain is not expected to be as high as the 34.1 per cent increase in 1947. Increased shipments of condensate to refineries as well as plant production of finished gasoline, naphthas, and specialty items should bring the production of miscellaneous products to near the billion-gallon level this year.

Total production at all natural-gasoline and cycling plants averaged 16,674,000 gal. per day in December 1947, and the increases in plant capacity during 1948 should result in an average production for the year of at least 16,800,000 gal. per day.

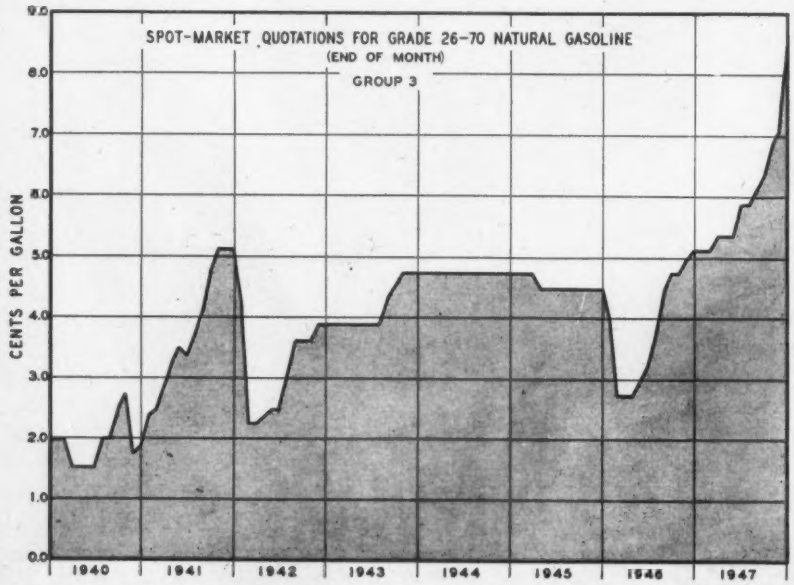
Monthly production increases reached a peak in December when the total output exceeded previous December by 2,420,000 gal. per day



PRODUCTION AT NATURAL-GASOLINE AND CYCLING PLANTS IN 1947—BY MONTHS*

	Thousands of gallons				Daily avg.	
	Natural gasoline	L.P.G.	Other products	Total	Thous. of gal.	Thous. of bbl.
January	216,157	154,884	72,930	443,971	14,322	341
February	194,771	153,478	66,060	414,309	14,797	352
March	218,848	167,259	73,899	460,006	14,839	353
April	222,327	154,702	74,597	451,626	15,054	358
May	235,321	128,695	70,373	434,389	14,013	334
June	236,004	135,749	67,352	439,105	14,637	349
July	242,788	143,452	74,466	460,706	14,861	354
August	241,954	151,181	77,437	470,572	15,180	361
September	237,568	152,228	74,152	463,948	15,465	368
October	241,696	167,483	79,500	488,679	15,764	375
November	225,638	185,346	88,858	499,842	16,661	397
December	230,765	195,067	91,059	516,891	16,674	397
Total 1947	2,743,837	1,889,524	910,683	5,544,044	15,189	362
Total 1946	2,691,001	1,409,345	760,687	4,861,033	13,318	317
Per cent increase	2.0	34.1	19.7	14.1	.....	....
Per cent of total prod.	49.5	34.1	16.4	100.0	.....	....

*U. S. Bureau of Mines.



Spot-market quotations for grade 26-70 natural gasoline in Mid-Continent area climbed to 8½ cents per gallon by the end of 1947, indicating increased demand

Survey of Natural-Gasoline Plants

Compiled by The Oil and Gas Journal's Statistical Department

PRESENTED here is The Oil and Gas Journal's 1948 survey of 513 natural-gasoline and cycling plants, another special service to Journal readers. Compiled from information obtained directly from the various operating companies in the United States, this report on plant operations is the most complete of its kind available to the petroleum industry.

LIGHT hydrocarbon liquid production capacity of the nation's natural gas processing plants this year reflects the results of the industry's efforts to reduce the gap between consumer demand and plant output. Although capacity increases for all U. S. plants have been upped appreciably the margin between production and demand is now greater than that of recent years.

A large number of new installations contributed substantially to the capacity increases during the past year. However, improved operating efficiencies incorporated into the older installations also provided a sizable increase to 1947 capacities.

The highly favorable L.P.G. market has made economical the installation of propane and butane extraction facilities at many of the smaller plants and at some of the larger plants, which heretofore were equipped to extract only natural gasolines. With few probable exceptions most of these plants which have been revamped to extract L.P.G. fractions were also expanded to manufacture the higher vapor pressure natural gasolines. Reports show that some of these plants have been modernized to improve operating efficiencies.

Upwards of 50 per cent of all plants included in this year's survey reports are equipped to produce L.P.G. Reports on the various companies which are planning to expand L.P.G. production capacities indicate that considerably more than 50 per cent of all plants operating by or before the end of 1948 will be equipped to produce L.P.G. materials.

New Construction Under Way

New construction now under way and planned reveals that the industry's plant capacity for the U. S. may be well over 20-million gallons per day of liquid production on or before the end of 1949. In addition to the announced natural gasoline and cycling plant expansion projects (see page...) several of the major operators in the industry are designing a number of projects which are expected to be authorized soon.

The trend in new plant construction runs to the larger plants for the average installation. Some of the new plants are shown to have input capacities upwards of 250,000,000 cu. ft. per day and several of the expanded and modernized installations have capacities of twice that volume. Average input capacity of the newer plants located in the larger natural gas producing areas is nearly 100-million cubic feet per day.

NATURAL-GASOLINE PLANTS

State—	Production* capacity, gal. per day	No. of plants†
Arkansas	348,500	9
California	2,347,500	74
Colorado	6,000	1
Illinois	604,350	9
Kansas	419,100	12
Kentucky	84,000	5
Louisiana	600,350	24
Montana	27,000	1
New Mexico	510,400	7
Ohio	45,000	6
Oklahoma	1,861,000	78
Pennsylvania	121,199	36
Texas	7,107,900	138
West Virginia	382,800	58
Wyoming	197,100	6
Total (gasoline plants)	14,662,199	464
CYCLING PLANTS		
California	364,000	2
Colorado	800	1
Louisiana	1,853,000	9
Mississippi	152,400	1
Texas	2,897,250	36
Total (cycling plants)	5,267,450	49
Totals (gasoline and cycling plants)	19,929,199	513

*Liquid production including liquefied petroleum gases. †Producing 100 or more gallons per day of liquid.

ARKANSAS

Company, field or plant, and county—	Approx. cap. (gal. per day)
Arkansas Fuel Oil Co., Dorcheat, Columbia	*105,000
Arkla Oil Co., North Rodessa, Miller	*26,000
Barnsdall Oil Co., Midway, Lafayette	*30,000
Hiwan Oil & Gas Co., Atlanta, Columbia	*20,000
Lion Oil Co., Schuler, Union	*22,000
Magnolia Petroleum Co., Kenova, Union	*5,500
McKamie Gas Cleaning Co., McKamie, Lafayette	*40,000
Querbes Oil Co., Southfield, Union	15,000
Shell Oil Co., Inc., Magnolia, Columbia	*85,000
Total	348,500

CALIFORNIA

Bankline Oil Co., Long Beach, Los Angeles	*50,000
Belridge Oil Co., North Belridge, Kern	*100,000
Coline Gasoline Co., Rincon, Ventura	*25,000
Continental Oil Co., San Miguelito, Ventura	15,000
Cowan Oil & Ref. Co., Rosecrans, Los Angeles	10,000
Del Valle Gasoline Co., Del Valle, Los Angeles	30,000
Fullerton Oil Co., Huntington Beach, Orange	*80,000
General Petroleum Corp.:	
Athens, Los Angeles (fractionating plant)	*210,000
Brea-Olinda, Orange	20,000
Helm, Riverdale, Lanare, Fresno	*60,000
Santa Fe Springs, Los Angeles	50,000

Company, field or plant, and county—	Approx. cap. (gal. per day)
Ventura, Ventura	40,000
Wilmington, Los Angeles	75,000
Honolulu Oil Corp., Buena Vista Hills, Kern	30,000
Inglewood Gasoline Corp., Inglewood, Los Angeles	6,000
Lomita Gasoline Co.:	
Long Beach (1), Los Angeles	*85,000
Long Beach (4), Los Angeles	30,000
Lytle, R. S., Operator, Coalinga Nose, Fresno	*50,000
Magruder, P. S., Operator:	
Kettleman Hills, Kings, Huffman	*110,000
Kettleman Hills, Kings (Western States)	*130,000
Natural Gasoline Co., Torrance, Los Angeles	21,000
Norwalk Co., The:	
Midway-Sunset, Kern	*25,000
Santa Fe Springs, Los Angeles	*50,000
Rice Ranch Oil Co., Orcutt, Santa Barbara	3,000
Richfield Oil Corp.:	
North Coles Levee, Kern	*86,000
Long Beach, Los Angeles	20,000
Shell Oil Co., Inc.:	
Brea-Olinda, Orange	25,000
Capitan, Santa Barbara	5,000
Dominguez, Los Angeles	25,000
Long Beach, Los Angeles	60,000
Orcutt, Santa Barbara	2,500
Ten Section, Kern	125,000
Ventura, Ventura	*175,000
Signal Oil & Gas Co.:	
Elwood (10), Santa Barbara	20,000
Huntington Beach (11), Orange	90,000
Long Beach (2), Los Angeles	65,000
Standard Oil Co. of California:	
(19-B) Coalinga, Fresno	38,000
Greeley, Kern	*20,000
Huntington Beach (4), Orange	*40,000
Inglewood, Los Angeles	35,000
(11-P) Kettleman Hills, Kings and Fresno	*50,000
(3-P) Kettleman Hills, Kings and Fresno	*78,000
(33-J) Kettleman Hills, Kings and Fresno	*50,000
Lost Hills, Kern	4,000
(31-E) Maricopa, Kern	10,000
(1-C) Midway, Kern	*20,000
(7-D) Midway, Kern	20,000
(29-G) Midway, Kern	12,000
Murphy-Coyote, Los Angeles and Orange	*80,000
32-Z) Mountain View, Kern	16,000
Santa Fe Springs, Los Angeles	40,000
Seal Beach, Orange	25,000
Torrance, Los Angeles	12,000
Wasco, Kern	6,000
Superior Oil Co., Rio Bravo, Kern	*20,000
Texas Co., The:	
Santa Fe Springs, Los Angeles	*36,000
Signal Hill, Los Angeles	*70,000
Shiells Canyon, Ventura	*50,000
Whittier, Los Angeles	*44,000
Tide Water Associated Oil Co., Ventura (3 plants)	*130,000
Union Oil Co.:	
Brea, Orange	26,000
Dominguez, Los Angeles	60,000
Orcutt, Santa Barbara	*29,000
Playa del Rey, Los Angeles	12,000
Richfield, Orange	13,000
Rosecrans, Los Angeles	27,000
Santa Fe Springs, Los Angeles	50,000
Santa Maria, Santa Barbara	*50,000
U. S. Navy Petroleum Reserve, Standard of California Operator, Elk Hills, Kern	6,000
West Coast Refining Co., Richfield, Orange	*50,000
West Rosecrans Gasoline Co., Rosecrans, Los Angeles	5,000
Wilmington Gasoline Co., Wilmington, Los Angeles	*110,000
Total	2,347,500

COLORADO

Mountain States Oil Corp., (3-33s-62w), Trinidad	6,000

ILLINOIS

Arkansas Fuel Oil Co., Robinson, Crawford	150
Brenneman & MacDonnel, Condry, Crawford	1,500
Carter Oil Co., The, Loudon, Fayette	*70,000
Engle Petroleum, Inc., The, Benton, Franklin	*10,000
Ohio Oil Co., The, Casey	1,200
Texas Co., The:	
Hoodville, Hamilton	*125,700
Salem, Marion	*196,800
Warren Petroleum Corp.:	
Crossville, White	*100,000
Salem, Marion	*100,000
Total	604,350

KANSAS

Company, field or plant, and county—	Approx. cap. (gal. per day)
Barnsdall Oil Co., Rainbow Bend, Cowley	*5,000
Cities Service Oil Co.:	
Main Line, Sedgwick	*104,000
Main Line, Cowley	*30,000
Burrton, Reno	*30,000
Continental Oil Co., No. 9, Cowley	25,000
Edwards Gasoline Co., Zenith, Stafford	2,000
Flynn Oil Co., Otis, Rush	*8,000
Kansas P. & L. Co.:	
Medicine Lodge, Barber	15,000
McPherson, McPherson	15,000
Northern Natural Gas Co., Hugoton, Seward	*71,700
Panhandle Eastern P. L. Co., Hugoton, Seward	55,000
Skelly Oil Co., Cunningham, Kingman	*50,000
Texas Co., The, Bearden, Cowley	*8,400
Total	419,100

KENTUCKY

Ashland Oil & Refining Co.:	
Big Sinking, Lee	4,000
Martha, Johnson	1,000
Kentucky-West Virginia Gas Co., Dwale, Floyd	5,000
Virginian Gasoline & Oil Co.:	
Catlettsburg, Boyd	*54,000
Warfield, Martin	*20,000
Total	84,000

LOUISIANA

Company, field or plant and parish—	
Anchor Gasoline Corp.:	
Eola, Avoyelles	*40,000
Pine Prairie	*15,000
Anse La Butte Gasoline Co., Anse La Butte, St. Martin	*15,000
Arkansas Fuel Oil Co.:	
Bisteneau, Bienville	*21,000
Homer, Claiborne	5,000
Rodessa, Caddo	*23,500
Shreveport, Caddo	*17,600
Sligo, Bossier	*18,500
Arkla Oil Co., North Rodessa, Miller	*26,000
Atlantic Refining Co., Neale field, Beauregard	*40,000
Carter Oil Co., The, Stiles, Caddo	6,000
Cheneyville Gasoline Co., Cheneyville	7,500
Coltexo Corp., Rodessa, Caddo	*50,000
Continental Oil Co.:	
English Bayou, Calcasieu	22,750
Tepetate, Acadia	15,000
Ville Platte, Evangeline	*120,000
Glen Rose Gasoline Co., Rodessa, Rodessa	*50,000
Great National Oil Corp. of Louisiana, Ida, Caddo	35,000
Gulf Refining Co., Homer, Claiborne	10,000
Ohio Oil Co., The, Haynesville, Claiborne	*3,000
Shell Oil Co., Inc., Iowa, Calcasieu	15,000
Stanolind Oil & Gas Co., Pine Island, Caddo	4,000
Texas Co., The, Lafitte, Jefferson	12,500
United Gas P. L. Co., Sugar Creek, Claiborne	*30,000
Total	600,350

MONTANA

Union Oil Co. of California, Cut Bank, Glacier	*27,000

NEW MEXICO

El Paso Natural Gas Co.:	
Jal, Lea	*67,800
Langley-Mattix, Lea	*112,600
Loco Hills Press. Maint. Co., Loco Hills, Eddy	10,000
Maljamar Coop., Maljamar, Lea	*15,000
Phillips Petroleum Co.:	
Eunice, Lea	*120,000
Hobbs, Lea	*105,000
Skelly Oil Co., Eunice, Lea	*80,000
Total	510,400

OHIO

Preston Oil Co., The:	
Elk, Noble	2,000
Homer, Licking	15,000
Pavonia, Richland	10,000
Sugar Grove, Fairfield	9,000
York, Medina	5,000
River Gas Co., Ludlow, Monroe	4,000
Total	45,000

OKLAHOMA

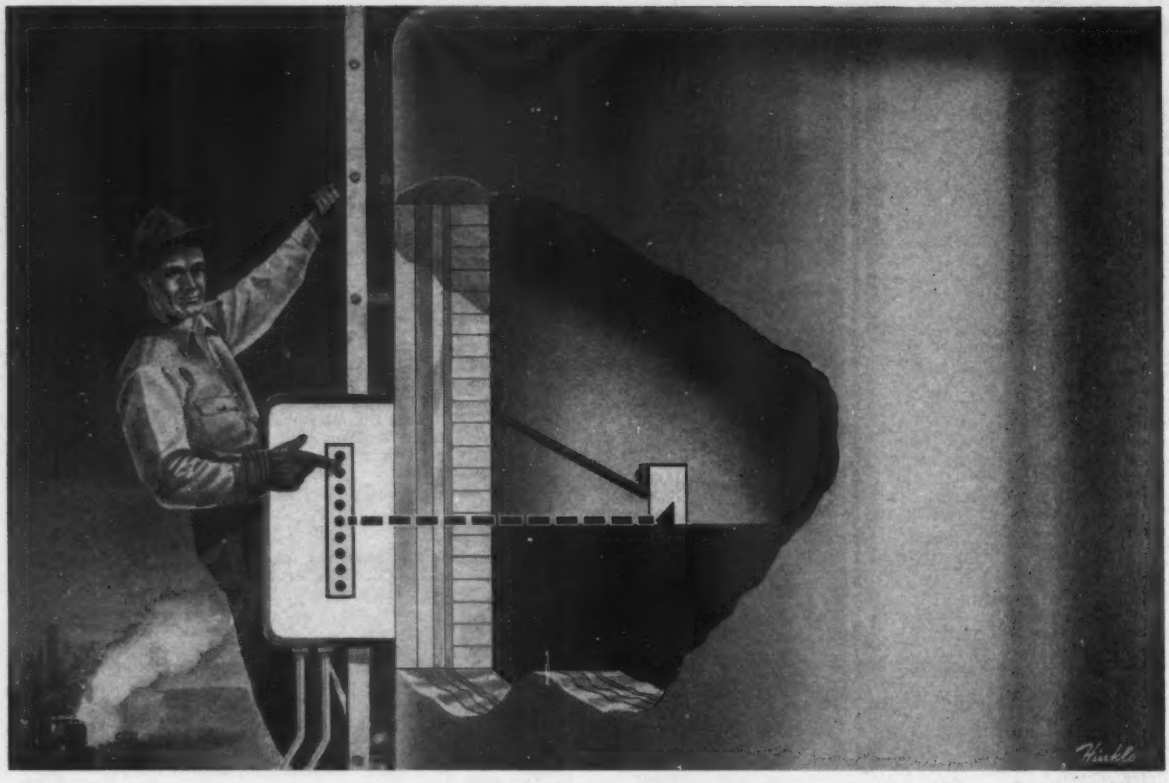
Company, field or plant, and county—	Approx. cap. (gal. per day)
Anchor Petroleum Co., Coyle, Logan	*8,500
Barksdale Co., Barksdale, Hughes	500
Barnsdall Oil Co.:	
Avant, Osage	*3,000
Seminole, Pottawatomie	*30,000
Carter Oil Co., The:	
Cromwell, Seminole	50,000
Fitts, Pontotoc	*60,000
Grisso, Seminole	*50,000
Cimarron Gasoline Corp.:	
Coyle, Logan	10,000
Guthrie, Logan	15,000
Cities Service Oil Co.:	
Bodine, Oklahoma	*30,000
Guymon, Texas	10,000
Mainline, Osage	10,000
Seminole, Seminole	8,000
Continental Oil Co., Billings, Noble	*32,100
Crosbie, J. E., Inc.:	
Fitts, Pontotoc	*16,000
Stroud, Creek	*10,000
Deep Rock Oil Corp., W. Norfolk, Payne	600
Devonian Oil Co., Osage	*20,000
Frame Natural Gas Co.:	
Plant 1, Pawnee	3,000
Plant 2, Pawnee	1,500
Grimes, Chas. W. and Otha H.:	
Okemah, Okfuskee	1,000
Weleetka, Okfuskee	*10,000
Grimes, Otha H.:	
Pauls Valley, Garvin	*40,000
Wetumka, Hughes	*6,000
Grimes Gasoline Co., Coon Creek, Oklahoma	*12,000
Gulf Oil Corp.:	
Boston, Osage	1,500
Burbank, Osage	10,000
Kiefer, Creek	20,000
Mission, Seminole	12,500
Keener Oil & Gas Co., Bartlett, Custer	*35,000
Lone Star Gas Co., Hollis, Harmon	*25,000
Magnolia Petroleum Co.:	
Davenport, Lincoln	*3,500
Graham, Carter	4,600
Stonewall, Pontotoc	*30,000
St. Louis, Pottawatomie	*16,000
Mid-Continent Petroleum Corp.:	
Cromwell (7), Seminole	15,000
Leonard (9), Tulsa	200
Sawyer (3), Creek	7,000
Stillwater (18), Payne	5,000
Stone Bluff (4), Wagoner	600
Neal Gasoline Co., Osage, Osage	5,700
Phillips Petroleum Co.:	
Denoya, Osage	*67,000
Edmond, Oklahoma	*80,000
Hunton, Oklahoma	*30,000
Oklahoma City, Oklahoma	*113,000
Reserve, Osage	*29,000
Wewoka, Seminole	*35,000
Pioneer Corp., Bixby, Tulsa	900
Powers, M. F., Depew, Creek	*2,000
Pure Oil Co.:	
Cushing, Creek	5,000
Glenn Pool, Creek	6,000
Shell Oil Co., Inc.:	
Healdton, Carter (Harry Ellis, Inc., Operator)	12,000
Hewitt, Carter	16,000
Lucien, Noble	*44,000
Osage, Osage	10,000
Tonkawa, Noble	10,000
Sinclair Prairie Oil Co.:	
Covington (6), Garfield	*40,000
Drumright (2), Creek	25,000
Seminole (13), Seminole	*210,000
Shamrock (3), Creek	20,000
St. Louis (14), Pottawatomie	30,000
Seminole (12), Seminole	50,000
Skelly Oil Co., Burbank, Osage (5 plants)	*200,000
Swab & Co., Edmond, Oklahoma	*5,000
Texas Co., The:	
Davenport, Lincoln	*20,000
Glenn Pool, Creek	6,800
Osage, Osage	*4,400
Tide Water Associated Oil Co., Drumright, Creek	15,000
Victor Gasoline Co., Bristow, Creek	2,000
Warren Petroleum Corp.:	
Graham, Carter	*22,000
Madill, Marshall	*60,000
Maud, Pottawatomie	*35,000
Fitts, Pontotoc	*18,000
Stroud, Lincoln	*9,000
Total	1,861,000

PENNSYLVANIA

Company, field or plant, and county—	Approx. cap. (gal. per day)
Alum Rock Gas Co., Fern, Clarion	300
Bayliss & Bayliss, Titusville	10,000
Clinger Oil & Gas Co.:	
Tidioute, Fagundus	1,000
Tidioute, Hastings	1,000
Ellenburger, W. J., & Sons, Karns City	300
Equitable Gas Co.:	
Marianna, Washington	2,000
Rogersville, Green	10,000
Haskell, Roth & Bayless, Tidioute, Warren	10,000
Hickey & Russell, Henry's Mill	300
Jennings, E. H., Bros. Co., McDonald (2 plants)	1,700
Manufacturers Light & Heat Co.:	
Elwood City, Lawrence	7,000
Lewis Run, McKean	5,000
Mars Co.:	
Lewis Run, McKean	6,500
Pinegrove, Venango	4,000
Van, Venango	*9,500
Pennsylvania Oil Co., Sheffield, Warren	10,000
Peoples Natural Gas Co., The, Brave, Greene	40,000
South Penn Oil Co. (15 plants)	950
Surety Oil Co.:	
Tiona, Warren	500
Titusville	1,000
Trueman's Forrest	149
Total	121,199

TEXAS

Company, field or plant, and county—	Approx. cap. (gal. per day)
Abercrombie Co., J. S., Old Ocean, Brazoria and Matagorda	*215,000
Absorption Plant, Inc., Winnie, Jefferson	*100,000
Anzak Oil Corp., Overall, Coleman	500
Arkansas Fuel Oil Co.:	
Carthage, Panola (2 plants)	*103,250
East Texas, Gregg	*80,000
Jefferson, Marion	5,000
Rodessa (Jefferson area), Marion	*24,500
Waskom, Harrison	*51,000
Agua Dulce Co., Nueces, Nueces	*40,000
Bennett Oil & Refining Co., Refugio, Refugio	20,000
Big Lake Oil Co., Big Lake, Reagan	50,000
Cabot Carbon Co.:	
Kermit, Winkler	*40,000
Wickett, Ward	*30,000
Canadian River Gas Co., Panhandle, Moore	50,000
Cannon Gasoline Co., Panhandle, Potter	*10,000
Caska Corp., Quitman, Wood	15,000
Chicago Corp., Carthage, Panola	*135,000
Cities Service Oil Co.:	
Odessa, Ector	30,000
Pampa, Gray	*29,000
Coltexo Corp., Panhandle, Gray	35,000
Columbian Gasoline Corp., Panhandle, Wheeler	15,000
Consolidated Gasoline Co., Martin, Eastland	4,000
Continental Oil Co.:	
K.M.A. plant, Wichita	120,000
Rincon, Starr	*30,000
Danciger Oil & Refining Co., Pledger, Matagorda	*40,000
Del Rey Petroleum Co., Hardin, Liberty	*12,000
Desdemona Gasoline Co., Desdemona, Comanche	3,000
Duval Gasoline Co., Benavides, Duval	*12,500
Federal Oil & Gas Industries, Inc., Joyce Richardson, Harris	*20,000
Fullerton Oil Co., Fullerton, Andrews	120,000
Gregg-Tex Gasoline Corp., E. Texas, Gregg	*150,000
Gulf Oil Corp.:	
East Texas, Gregg	*168,000
East Texas, Rusk	*42,000
North Ward-Estes, Ward	30,000
Hagy, Harrington & Marsh, Panhandle, Carson	*100,000
Hamman Oil & Refining Co., Hamman, Matagorda	10,500
Hargraves, F. E., Boggey Creek, Anderson	3,000
Henderson Trust No. 2, W. Panhandle, Hutchinson	40,000
Hilander Gasoline Co., Reed, Montague	4,000
Huber, J. M., Corp., Panhandle, Hutchinson	25,000
Humble Oil & Refining Co.:	
American, Rusk	44,000
Anahuac, Chambers	36,000
Clear Lake, Friendswood, Harris	35,000
Conroe, Montgomery	18,000
Flour Bluff, Nueces	14,000
Heyser, Calhoun	11,000
Kilgore, Rusk	44,000
London, Rusk	*180,000



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In a Propane de-asphalting plant, the sludge is agitated by steam. This frequently formed foam which failed to support the floats of ordinary gauges. The foam would boil up the vent pipes and out, making it necessary to shut down for a clean-up. The GAGETRON radium source was installed on brackets at the highest level to which the sludge should reach. When the fluid, or foam, level rises to interfere with the gamma rays to the receiver unit, mounted on the outside of the tank wall, a signal is transmitted to a recording controller which opens a steam valve to the discharge pump and the level is lowered. GAGETRON SAVED DOWN-TIME; INCREASED EFFICIENCY.

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Charcas 1775 Buenos Aires, Argentina

Company, field or plant, and county—	Approx. cap. (gal. per day)
Tomball, Harris	34,000
Tom O'Connor, Refugio	*60,000
Lisbon Gasoline Co., E. Texas, Rusk	*125,000
Lone Star Gas Co.:	
Gordon, Palo Pinto	*40,000
Pueblo, Eastland	10,000
Trinidad, Henderson	*55,000
Lone Star Producing Co.:	
Breifenridge, Stephens	40,000
Ranger, Eastland	*40,000
Magnolia Petroleum Co.:	
Burkburnett, Wichita	40,000
Desdemona, Eastland	*4,500
Electra, Wilbarger	6,000
Kermit, Winkler	*18,000
Olden, Eastland	*4,500
Sabine, Gregg	*40,000
Vanderbilt, Jackson	*30,000
Mid-Co Gasoline Co., Mid-Co, Henderson	*6,000
Midland Gasoline Co., Monroe, Montgomery	*45,000
Moncrief, W. A., & Sons:	
Archer, Chalk Hill	*1,000
Wichita-K.M.A.	*2,000
Nash Gasoline Co.:	
James, Young	*8,000
South Bend, Young	*15,000
Natural Gasoline Corp., Hawkins, Wood	*100,000
Nine Oaks Gasoline Co., Gladewater, Gregg	750
Odessa Natural Gasoline Co., Foster, Ector	*30,000
Parade Co., East Texas, Rusk	*150,000
Pewitt, P. H., Joaquin, Shelby	2,000
Phillips Petroleum Co.:	
Bowers, Gray	*34,000
Canadian, Hutchinson	*52,000
Crane, Crane	*42,000
Eliasville, Stephens	*15,000
Fullerton, Andrews	*110,000
Goldsmith, Ector	*72,000
Gray, Gray	*105,000
Hansford, Hansford	*103,000
Ibex, Shackelford	12,000
Johnson, Hutchinson	*90,000
Judkins, Ector	*42,000
Lefors, Gray	*33,000
Lodi, Cass	25,000
Mankins, Wichita	*75,000
North, Gray	*42,000
Pampa, Gray	*67,000
Pantex, Hutchinson	*44,000
Rock Creek, Hutchinson	*165,000
Sanford, Hutchinson	*133,000
Seminole, Gaines	*63,000
Sneed, Moore	*133,000
Portland Gasoline Co., Panhandle, Gray	*50,000
Pure Oil Co., Van, Van	*65,000
Roeser & Pendleton:	
Cook, Shackelford	7,000
Bluff Creek, Shackelford	3,000
Rudco Oil & Gas Co.:	
Desdemona, Eastland	5,000
Rising Star, Brown	5,000
Shamrock Oil & Gas Corp., The:	
Panhandle, Moore (McKee Plant)	*210,000
Panhandle, Moore (Sunray Plant)	100,000
Shell Oil Co., Inc.:	
Panhandle (1), Carson	5,000
Panhandle (2), Carson	25,000
Panhandle, Gray	15,000
Wasson (1), Yoakum	57,600
Wasson (2), Yoakum	58,000
Sinclair Prairie Oil Co.:	
Gladewater, Gregg	*275,000
East White Point, San Patricio	*30,000
Troup, Rusk	*120,000
Skelly Oil Co., West Pampa, Carson (4 plants)	*230,000
Southern Minerals Corp.:	
Saxet, Nueces	*25,000
Stratton, Nueces	*15,000
Standard Oil Co. of Texas, South Ward, Ward	23,500
Stanolind Oil & Gas Co.:	
Luby, Nueces	*45,000
Hastings, Brazoria	*60,000
Texas Co., The:	
Burkburnett, Wichita	5,800
Electra, Wichita	*18,500
Texas Pacific Coal & Oil Co., Caddo, Stephens	*12,000
Texoma Natural Gas Co.:	
Fritch, Hutchinson	85,000
Stinnett, Moore	44,000
Tucker Oil Co., Burkburnett, Wichita	1,500
United Gas Pipe Line Co.:	
Agua Dulce, Nueces	*50,000
Carthage, Panola	*165,000
Waggoner, W. T., estate, Waggoner, Wilbarger	7,000
Warren Petroleum Corp.:	
Breckenridge, Stephens	*60,000
Fairbanks, Harris	*40,000
Gladewater, Gregg	*175,000
Holliday, Archer	*80,000
McLean, Gray	*55,000
West Gasoline Co., Cleveland, Liberty	*12,000
West Texas Gas Co., W. Panhandle, Potter	20,000
Witco Hydrocarbon Corp., Barnhart, Reagan	*90,000
Total	7,107,900

WEST VIRGINIA

Carnegie Natural Gas Co., Hundred, Wetzel	1,400
Dinsmoore & Co., St. Mary's Sugar Creek, Shawnee, Henry Camp, Bills 10-Acre, Fetty, Roby, Brush Run and Pike plants	200
Falling Rock Channel Coal Co., Falling Rock	3,000
Hapgood, Roswell T., & Co., Cedar Grove, Kanawha	7,000
Hope Natural Gas Co.:	
Bristol, Harrison	8,000
Cornwell, Kanawha	14,000
Goff, Harrison	5,000
Hastings, Wetzel	60,000
Kennedy, Lewis	20,000
Waverly, Wood	8,000
Jennings, E. H., Bros. Co., Jacksonburg, Wetzel (2 plants)	1,800
Manufacturers Light & Heat Co., The:	
Roby's Rock, Marshall	8,000
Station A, Brooke	5,000
Owens, Libby-Owens Gas Dept., Kanawha, etc.	*15,000
Pure Oil Co., (Dawes), Cabin Creek	*9,000
South Penn Natural Gas Co.:	
Bennett, Gilmer	500
Blackshere, Marion	800
Broadwater, Tyler	300
Clay, Clay	2,500
Coldwater, Harrison	300
Copley, Lewis	800
Edgell, Roane	1,200
Fairview, Monongalia	3,000
Falling Rock, Kanawha	1,000
Griffith, Lincoln	2,000
Hartley-Stephens, Ritchie	3,000
Liverpool, Jackson	500
Lynch, Harrison	3,500
McElroy, Tyler	500
Metz, Marion	1,200
Morgan, Wetzel	3,200
Oilsiding, Kanawha	500
Pine Grove, Wetzel	3,500
Prutny, Ritchie	300
Rock Creek, Roane	1,200
Seckman, Tyler	500
Shinnston, Harrison	500
Stringtown, Tyler	3,000
Sweeney, Tyler	500
Tanner, Gilmer	500
Victor, Kanawha	3,500
Wood, Elk Fork, Eddy, Tyler	1,000
Union Gasoline & Oil Corp.:	
Jane Lew, Lewis	3,000
Moundsville, Marshall	3,000
Porter Falls, Wetzel	10,000
Virginian Gasoline & Oil Co.:	
Charleston, Kanawha (2 plants)	17,000
Clendenin, Kanawha	40,000
Hubball, Lincoln	12,000
Jarretts Fords, Kanawha	18,000
Mammoth, Kanawha	2,500
Ona, Cabell	18,000
St. Albans, Kanawha	3,500
Sandyville, Jackson	*34,000
Spencer, Roane	12,000
Three Mile, Kanawha	3,500
Walgrove, Kanawha	1,000
Total	382,800

WYOMING

Continental Oil Co., Lance Creek, Niobrara	*83,500
Northern Utilities Co., Sand Draw, Fremont	4,500
Ohio Oil Co., The:	
Grass Creek, Hot Springs	3,600
Rock River, Albany	*7,500
Sinclair-Wyoming Oil Co., Lost Soldier, Sweetwater	5,000
Stanolind Oil & Gas Co., Salt Creek, Natrona	*93,000
Total	197,100

*L.P.G. produced.

Survey of Cycling Plants

Company, field or plant and county—	Approx. cap., gal. per day
CALIFORNIA	
Ohio Oil Co., South Coles Levee, Kern	*284,000
Western Gulf Oil Co., Paloma, Kern	*80,000
Total	364,000
COLORADO	
Continental Oil Co., McCallum, Jackson	800
LOUISIANA	
Anchor Gasoline Corp., Eola	*30,000
Barnsdall Oil Co., Benton, Benton	*170,000
California Co., The, Lake St. John, Tensas	*152,400
Claiborne Gasoline Co., Lisbon, Claiborne	*200,000
Cotton Valley Oper. Comm., Cotton Valley, Webster	*450,000
Haynesville Operators, Haynesville, Claiborne	*50,000
Stanolind Oil & Gas Co., South Jennings, Jefferson Davis	*58,000
Texas Co., The, Operator:	
Erath, Vermilion	*672,000
Bateman Lake, St. Mary	75,600
Total	1,858,000
MISSISSIPPI	
California Co., The, Cranfield, Adams	*152,400
TEXAS	
American Liberty Oil Co., Blessing, Matagorda	40,000
American Republics, Joe's Lake, Tyler	12,000
Anco Gas Corp., Long Lake, Anderson	60,000
Chicago Corp., The:	
Gulf Plains, Stratton, Nueces	*125,000
Coastal, Plant, Nueces	*125,000
Wardner, Plant, Nueces	*125,000
Distillate Prod. Corp., North Houston, Harris	*84,000
Duval Gasoline Co., Southland, Duval	5,800
Francitas Gas Co., Francitas, Jackson	*44,000
Gasoline Production Corp., Bee	65,000
Geier-Jackson, Inc., Grapeland, Houston	75,000
Gulf States Recycling Co., San Sanvador, Hidalgo	12,600
Harrell, H. M., Ehrhardt, Harris	40,000
Humble Oil & Refining Co., Katy, Waller	*480,000
Hunt Oil Co., Long Lake, Anderson	50,000
Jim Wells Gas Co., Alice, Jim Wells	*42,000
L. M. Josey, Joyce Richardson, Harris	15,000
La Gloria Corp., La Gloria, Brooks	*320,000
Lockhart, L. M., Agua Dulce, Nueces	*40,000
Lone Star Production Co.:	
Grapeland, Houston	*25,000
Opelika, Henderson	*130,000
Carthage, Panola	100,000
Chapel Hill, Smith	130,000
Plymouth Oil Co., Plymouth, San Patricio	75,000
Roeser & Pendleton, Cayuga, Anderson	10,000
Shell Oil Co., Inc., Sheridan, Colorado	*282,000
Stanolind Oil & Gas Co.:	
La Rosa, Refugio	*50,000
South Jennings, Jefferson Davis	58,000
Superior Oil Co., Lake Creek, Montgomery	*140,000
Sun Oil Co.:	
Seabreeze, Chambers	14,000
Willow Slough, Chambers	12,000
Tide Water Associated-Seaboard:	
Cayuga, Anderson	30,000
Long Lake, Anderson	*40,000
Trinity Gas Corp., Sejita, Duval	*40,000
Western Natural Gas Co.:	
San Salvador, Hidalgo	250
San Salvador, Live Oak	600
Total	2,897,250

*L.P.G. produced.

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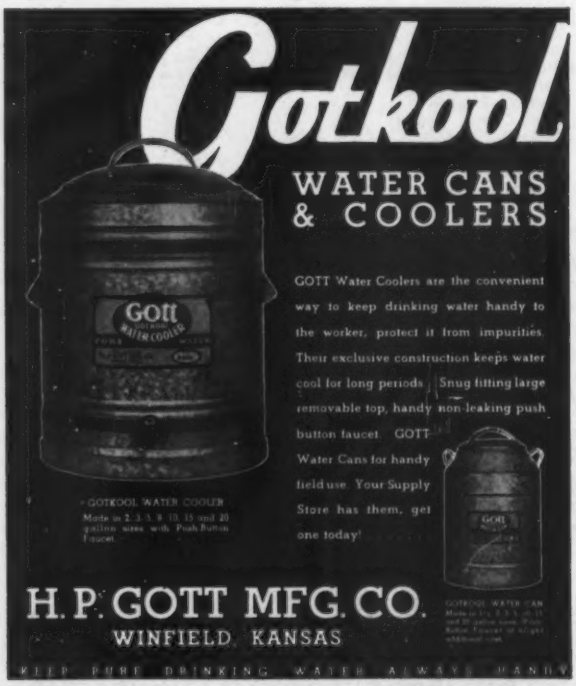
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Construction Under Way Will Increase Output of Natural-Gasoline, Cycling Plants

by R. B. Tuttle

NATURAL-GASOLINE and cycling-plant projects under construction or authorized and scheduled for completion during the coming year are 11-12 per cent of the capacity of currently operating plants. Some of the projects now in the building stage include expansions to existing installations. On a capacity basis these expansions contribute only slightly to the over-all gain. In several instances plant-expansion projects involve principally the addition of equipment or the revamping of existing facilities for the improvement of plant efficiencies in the production of L.P.G.

Currently the nation's 464 natural-gasoline plants and 49 cycling installations are given a total capacity of nearly 20 million gallons per day liquid production (see page 135).

Texas comes in for a substantial share of the industry's expansion program. When the new plants now building and authorized for construction in the state are placed in operation, natural-gasoline and L.P.G. production in Texas will probably be 60 per cent of the nation's total.

Projects planned, authorized, and building in Hugoton field, apart from the hydrocarbon-synthesis installation scheduled for that area, are rated at upwards of 200 million cubic feet per day gas input.

Plant expansion scheduled for California areas will step up natural-gas processing plant throughputs by some 74-80 million cubic feet per day during the early months of this year. Increases in production capacities are also scheduled for Arkansas, Louisiana, New Mexico, and Oklahoma areas.

GASOLINE AND CYCLING PLANT CONSTRUCTION

Company, location and type of project—	rating Capacity	Status	Comp. schedule	Contractors
Abercrombie Co., J. S., Old Ocean field, Texas:				
Revamp existing facilities	.....	Planned	1948	.....
American Republics Corp. and Houston Oil Co., Hardin County, Texas:				
Gasoline plant	.....	Building	Sept. '48	Gasoline Plant Construction Corp.
Arkla Oil Co., North Rodessa field, Arkansas:				
Installing engines, hp.	2,000	Under way	.....	.....
Barnsdall Oil Co., West Tepetate field, Louisiana:				
Gasoline plant	.....	Building	.....	.....
California Co., The, Hico, La.:				
Gasoline plant	.....	Building	.....	.....
California Co., The, Rangely, Colo.:				
Gasoline plant	.....	Building	.....	.....
Claiborne Gasoline Co., Lisbon, La.:				
Gasoline plant addition, cu. ft. per day	50,000,000	Building	Late '48	Petroleum Engineering, Inc.
Crosbie, J. E., Inc., Creek County, Oklahoma:				
Gasoline plant	.....	Building	.....	.....
Gray-Wolfe Co., The, Montgomery County, Texas:				
Cycling plant, cu. ft. per day	19,000,000	Building	Early '48	O. L. Olsen
Gregg-Tex Gasoline Corp., Gregg County, Texas:				
Additional facilities for propane extraction	.....	Building	.....	.....
Gulf Oil Corp., Drinkard, N. M.:				
Gasoline plant, cu. ft. per day	50,000,000	Building	Late '48	Hudson Engineering Co.
Humble Oil & Refining Co., Katy, Tex.:				
Cycling plant, expansion of facilities, cu. ft. per day	500,000,000	Building	May '49	Stearns-Roger Manufacturing Co.
Humble Oil & Refining Co., London plant, Overton, Tex.:				
Gasoline plant, expansion of facilities, cu. ft. per day	16,000,000	Building	June '48	Fish Engineering Corp.
Humble Oil & Refining Co., American plant, Overton, Tex.:				
Revamping gasoline plant, cu. ft. per day	9,500,000	Building	July '48	Fish Engineering Corp.
Humble Oil & Refining Co., Laird Hill, Tex.:				
Altering gasoline plant, cu. ft. per day	7,000,000	Building	Aug. '48	Fish Engineering Corp.
Lion Oil Co., Magnolia field, Arkansas:				
Increasing treating capacity, cu. ft. per day	2,000,000	Planned	.....	.....
Lone Star Producing Co., Henderson County, Texas:				
Gasoline plant expansion, gal. per day	20,000	Building	Sept. '48	.....
Magnolia Petroleum Co., Seeligson field, Texas:				
Cycling plant, cu. ft. per day	220,000,000	Building	Jan. '49	.....
Magnolia Petroleum Co., Mamou, La.:				
Gasoline plant, cu. ft. per day	7,000,000	Building	Nov. '48	Gasoline Plant Construction Corp.
Magnolia Petroleum Co., Hugoton field, Kansas:				
Gasoline plant, cu. ft. per day	75,000,000	Building	Nov. '48	.....
Pan American Producing Co., Kountze, Tex.:				
Cycling plant, cu. ft. per day	5,000,000	Building	Early '48	O. L. Olsen
Phillips Petroleum Co., Hunsford County, Texas:				
Gasoline plant, gal. per day	106,000	Authorized	.....	.....
Richardson & Bass, Kermit, Tex.:				
Gasoline plant, cu. ft. per day	130,000,000	Building	Late '48	Jones & Laughlin Supply Co.
Richfield Oil Corp., Kern County, California:				
Gasoline plant, cu. ft. per day	60,000,000	Building	Early '48	C. F. Braun Co.
Shamrock Oil & Gas Corp., The, Sunray, Tex.:				
Gasoline plant expansion, cu. ft. per day	50,000,000	Planned	1948	.....
Shell Oil Co., Inc., Denver City, Tex.:				
Gasoline plant	.....	Planned	.....	.....

(Continued on Next Page)

GASOLINE AND CYCLING PLANT CONSTRUCTION (Continued)

Company, location and type of project—	rating Capacity	Status	Comp. schedule	Contractors
Shell Oil Co., Inc., Ventura, Calif.:				
Gasoline plant increase, gal. per day	30,000	Planned	1948	
Skelly Oil Co., Velma pool, Oklahoma:				
Gasoline plant, gal. per day	75,000	Building	Early '48	Born Engineering Co.
Skelly Oil Co., Eunice, N. M.:				
Gasoline plant, gal. per day	45,000	Building	Early '48	J. E. Carlson Construction Co.
Stanolind Oil & Gas Co., Hugoton field, Kansas:				
Gasoline plant, cu. ft. per day	100,000,000	Authorized	Late '48	Jones & Laughlin Supply Co.
Stanolind Oil & Gas Co., Hockley County, Texas: Joint ownership				
Gasoline plant, cu. ft. per day	90,000,000	Building	Feb. '49	C. F. Braun Co.
Stanolind Oil & Gas Co., Park County, Wyoming: Joint ownership				
Gasoline plant, cu. ft. per day	12,000,000	Building	Apr. '49	Stone & Webster Engineering Corp.
Stanolind Oil & Gas Co., Bee County, Texas: Joint ownership				
Cycling plant, cu. ft. per day	166,000,000	Building	Apr. '49	Jones & Laughlin Supply Co.
Stanolind Oil & Gas Co., Levelland field, Texas: Joint ownership				
Gasoline plant	.....	Planned	.....	.....
Stanolind Oil & Gas Co., Fullerton field, Texas: Joint ownership				
Gasoline plant	.....	Planned	.....	.....
Stanolind Oil & Gas Co., North Cowden field, Texas: Joint ownership				
Gasoline plant	.....	Planned	.....	.....
Stanolind Oil & Gas Co., South Cowden field, Texas: Joint ownership				
Gasoline plant	.....	Planned	.....	.....
Sun Oil Co., Delhi, La.:				
Gasoline plant, cu. ft. per day	17,000,000	Building	Early '48	Petroleum Engineering Co.
Union Oil Co. of California, Cat Canyon field, California:				
Gas injection plant increase, cu. ft. per day	3,000,000	Authorized	Sept. '48	.....
Warren Petroleum Corp., Madill, Okla.:				
Gasoline plant, cu. ft. per day	25,000,000	Authorized	Late '48	Hudson Engineering Corp.
Warren Petroleum Corp., Holliday, Tex.:				
Gasoline plant expansion, cu. ft. per day	20,000,000	Authorized	Late '48	None
Warren Petroleum Corp., Maysville, Okla.: Joint ownership				
Gasoline plant, cu. ft. per day	50,000,000	Building	Late '48	Dresser Engineering Co.
Witco Hydrocarbon Corp., Reagan County, Texas:				
Gasoline plant, cu. ft. per day	25,000,000	Building	July '48	.....

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Salt Creek, Wyo., was the start of Stanolind's (predecessor company) natural-gasoline manufacturing. That was 30 years ago. This recent view shows how periodic revamping has kept that plant shipshape and abreast of processing improvements

Stanolind's GASOLINE PLANT *Program*

STANOLIND OIL & GAS CO.'s multimillion-dollar gasoline-plant expansion program is the story of an oil-producing company which is literally "exploding" into the natural-gasoline business. The company only a few years ago had very little in the way of a natural-gasoline department; at least the plants were few and the production relatively small. But soon, when the concern's eight-plant 1948-1949-1950 program is completed, Stanolind will have a huge gallonage figure and will become one of the dominant operators in the natural-gasoline industry.

This year marks the greatest expansion of natural-gasoline and L.P.G.-plant construction in the history of the industry. Illustrative of this trend is the Stanolind program. It is big—in total, for natural gasoline, cycling, and gasoline synthesis, exceeding 100 million dollars.

Thirty years span the interval between the first natural-gasoline op-

↓ In Operation — — Stanolind Oil & Gas Co. Has a Total of Ten Plants . . .

Operating

	Operating plants									
	Stanolind operated gasoline plants				Outside operated gasoline plants		Stanolind operated cycling plants		Outside operated cycling plants	
	Salt Creek	Gilliam	Luby	Hastings	Old Ocean	Hunton	South Jennings	La Rosa	Katy	Cotton Valley
Operator	Stanolind	Stanolind	Stanolind	Stanolind	Old Ocean Oil Co.	Phillips	Stanolind	Stanolind	Humble	Cotton Valley Operators Committee
Ownership	Stanolind	Stanolind	Joint	Stanolind	Joint	Joint	Stanolind	Stanolind	Joint	Joint
Location:										
County	Natrona	Caddo	Nueces	Brazoria	Brazoria	Oklahoma	Jefferson Davis	Refugio	Waller	Webster
State	Wyoming	Louisiana	Texas	Texas	Texas	Oklahoma	Louisiana	Texas	Texas	Louisiana
Start operation	1918	Dec. 1925	May 1939	Apr. 1947			Dec. 1941	Aug. 1940	Jan. 1943	June 1940
Capacity, M.c.f. per day	25,000	1,500	12,000	40,000	350,000	50,000	30,000	50,000	450,000	150,000
Input, M.c.f. per day	23,000	1,200	15,000	38,000	.....	.....	38,000	50,000	.....	.....
Comp., hp.	8,585	660	4,000	11,400	.....	.....	1,400	2,100	12,600	7,200
Products (gal. per day):										
Gasoline	61,000	3,000	28,000	22,000	.....	.....	27,000	15,000	.....	.....
Butane-propane	15,000	.....	13,000	25,000	.....	.....	6,000	1,000	.....	.....
Other	.....	.....	.....	.....	.....	.....	8,000	2,000	.....	.....
Total	76,000	3,000	41,000	47,000	.....	.....	41,000	18,000	.....	.....
Absorber pressure, psi.	125	40	125	700	1,750	60	2,000	1,500	1,800	1,500
Number of wells connected	832	235	127	660	155	.....	.....	.....	.....	125
Boilers, lb. steam per hour	34,000	4,900	26,400	90,000	.....	.....	21,300	19,600	195,000	.....
Generator, kw.	.....	.....	.....	2,250	.....	.....	.....	.....	.....	.....
Gas injection	Yes	Yes	Yes	Storage	Yes	No	Yes	Yes	Yes	Yes
Gas sale	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Water circulated, g.p.m.	6,500	200	3,400	10,000	.....	.....	1,500	.....	.....	.....
Oil circulated, g.p.m.	400	50	425	490	.....	.....	220	220	.....	.....

The Hastings, Tex., natural-gasoline plant is the latest Stanolind unit to go on stream under the firm's heavy expansion in extraction and processing of light hydrocarbons. The plant has 11,400 compressor horsepower, is connected to 660 wells

MEN WHO HEAD STANOLIND'S MANUFACTURING OPERATIONS

J. E. ROUSE

J. H. FORRESTER

J. E. Rouse is operating vice president of Stanolind. A 1913 graduate of Brown University, his first oil job was for Standard Oil Co. of New Jersey at Bayonne. In 1918, he joined Midwest Refining Co. In 1931, he was placed in charge of all refineries in the Rocky Mountain division of Standard of Indiana; in 1933, he was made assistant general manager of manufacturing. During World War II, he did special work for both PAW and the Navy. Rouse joined the Stanolind organization in November 1945 as manager of the manufacturing department, and on January 1, 1947, was elected director in charge of manufacturing and producing operations. He became operating vice president January 1, 1948.

J. H. Forrester is manager of Stanolind's manufacturing department. A graduate of University of Wisconsin and Massachusetts Institute of Technology, he started with Standard Oil Co. (Ind.) as chemical engineer at Whiting, held various positions in process design of refinery equipment and technical service to the manufacturing department, ending as associate director of research and director of technical service, before transferring to Stanolind in July 1946. He became manager of manufacturing, January 1, 1947.

eration of a predecessor-company natural-gasoline plant at Salt Creek, Wyo., and the present time. Now Stanolind has its ultramodern Hastings, Tex., plant on production along

. . . . . ↓ And Authorized or Under Construction Are Eight More Building

	Stanolind operated						Outside operated	
	Gasoline plants				Gasoline plant in synthesis plant	Cycling plant	Gasoline plants	
	Elk Basin	Slaughter	Stano (Hugoton)	Levelland	Garden City	Burnell-North Pettus	Rangely	Brookhaven
Operator	Stanolind	Stanolind	Stanolind	Stanolind	Stanolind	Stanolind	Calif. Co.	Calif. Co.
Ownership	Joint	Joint	Stanolind	Joint	Stanolind	Joint	Joint	Joint
Location:								
County	Parks	Hockley	Grant	Hockley	Finney	Bee	Rio Blanco	Lincoln
State	Wyoming	Texas	Kansas	Texas	Kansas	Texas	Colorado	Mississippi
Start operation	Apr. 1949	Feb. 1949	Dec. 1948	1949	Jan. 1950	Apr. 1949		
Capacity, M.c.f. per day	12,000	90,000	100,000	65,000	100,000	166,000	20,000	10,000
Comp., hp.	9,000	25,600	250	.....	.....	9,000	6,000	3,000
Products (gal. per day):								
Gasoline	17,000	100,000	27,000	.....	.....	150,000	55,000	.....
Butane-propane	39,000	150,000	37,000	.....	.....	119,000	67,000	.....
Other	.....	.....	.....	.....	.....	18,000	.....	.....
Total	56,000	250,000	64,000	.....	.....	287,000	122,000	.....
Absorber pressure, psi.	500	700	350	.....	.....	1,600	600	800
Number of wells connected	130	2,000	311	.....	.....	.....	.....	.....
Boilers, lb. steam per hour	110,000	60,000	70,000	.....	.....	180,000	30,000	.....
Generator, kw.	2,000	5,000	1,500	.....	.....	3,000	1,000	.....
Gas injection	Yes*	.....	No	.....	No	Yes	.....	.....
Gas sale	Yes	Yes	Yes	Yes	Yes	Yes	.....	.....
Water circulated, g.p.m.	4,000	21,000	3,000	.....	.....	15,000	9,000	.....
Oil circulated, g.p.m.	140	750	840	.....	.....	1,800	300	.....

*Inert gas injection; sulfur recovery.

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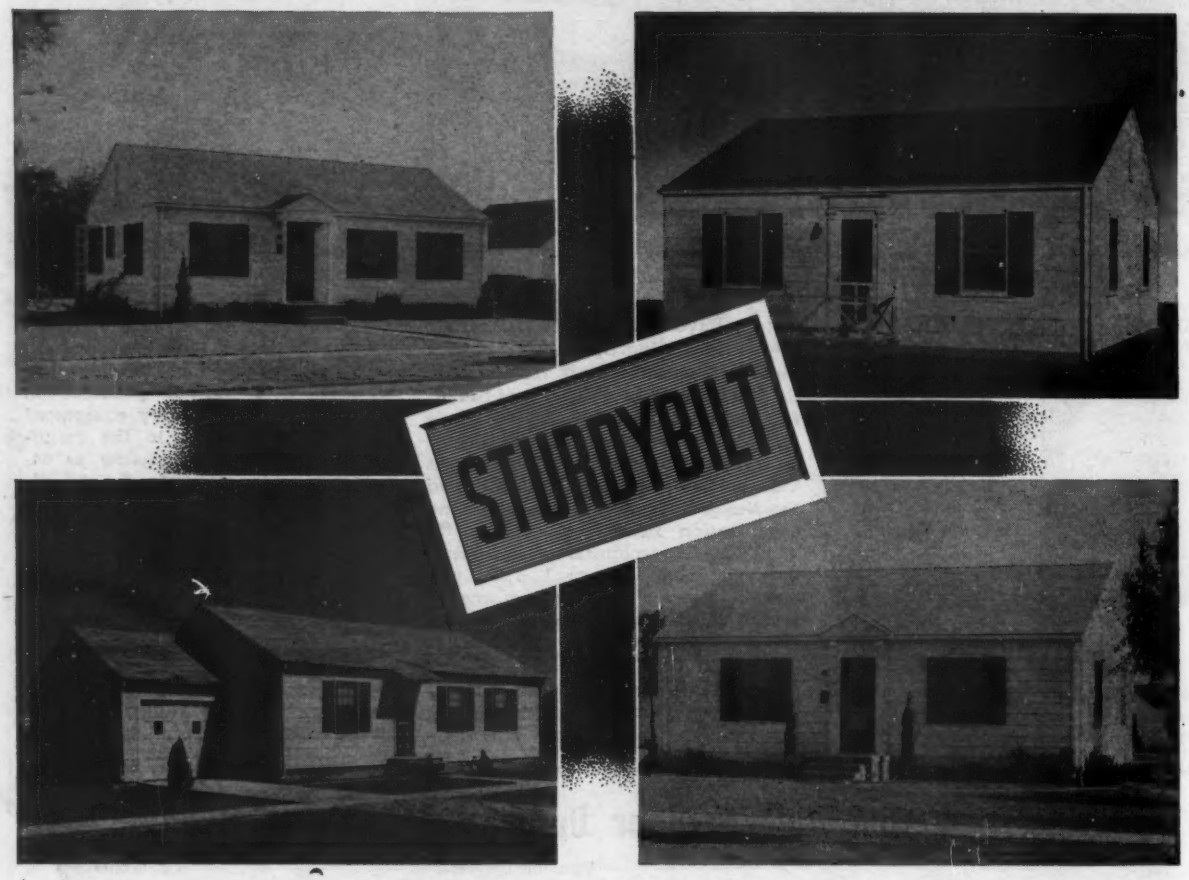

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with others in Texas, Louisiana, and Oklahoma. Some of these are wholly owned, but most are joint operations with other producers. In some, where Stanolind has a minority interest, they are operated by another company. In planning new plants in any field, Stanolind has invited all producers to participate. The original Salt Creek plant, incidentally, still remains in the growing list of the company's operations, and as a matter of fact, that first plant has been revamped, remodeled, and added to time after time to keep it abreast and take advantage of improved process design and equipment.

The future program of the company, however, is the real part of this story. Authorized and under construction are seven gasoline plants and one cycling project. All but two of these will be Stanolind operated. When this 1948-1950 construction program is finished, this construction phase alone will represent to the company new capital investment estimated to be in excess of 35 million dollars. Plants in which Stanolind has an interest then will be scattered through Texas, Louisiana, Mississippi, Oklahoma, Kansas, Colorado, and Wyoming.

Another index on the size of Stanolind's construction program in the natural-gasoline field is to be found in its steel-tonnage requirements. The natural-gasoline plants which Stanolind will construct and operate will require more than 36,000 tons of steel, excluding gathering systems. This amount does not include steel tonnage needed for plants constructed by outside companies nor the steel requirements for the synthesis plant.

Also to Make Gasoline Synthetically

Natural gas and its processing has become a big factor with Stanolind. In addition to the gasoline plants, the company has selected Garden City, Kans., as the site for its new hydrocarbon-synthesis plant that will convert natural gas into liquid fuels and chemicals. Figures indicate yields on the order of 2.52 gal. of high-quality gasoline and 0.42 gal. of distillate fuels will be obtained from each 1,000 cu. ft. of natural gas processed. The plant is being designed to process about 100,000,000 cu. ft. daily of low-heating-value gas, some of which currently is considered unsuitable for sale as fuel. Although the company has never made public an estimate of the cost of this program, outside observers have figured the ultimate cost of the synthesis project at about 80 million dollars.

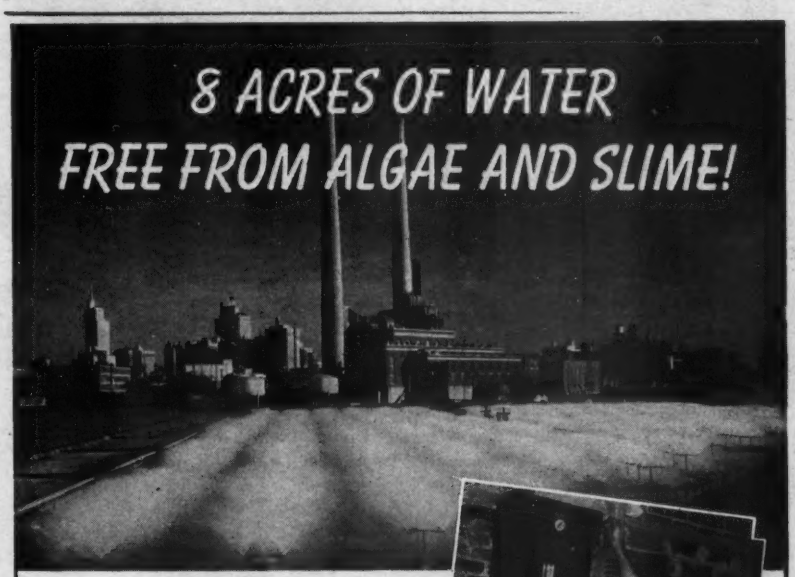
The largest oxygen plant in America will be built at the synthesis plant to supply oxygen for the process of converting natural gas to gasoline. Many major pieces of the processing equipment are being fabricated now and during the construction more than 200,000 tons of equipment and material will be used.

At the Kansas project, regular natural-gasoline plants again enter the picture as a 100,000,000-cu.-ft.-per-day natural-gasoline plant will be constructed at Garden City to tie in with the synthesis plant. The company's scheduled Stano, Kans., gasoline plant (100,000,000 cu. ft. per day) also will extract natural gasoline and L.P.G. components from Hugoton field gas with the dry gas being sold to Cities Service.

Careful planning and engineering of its natural-gasoline expansion program was started several years ago, and aggressive managerial and engineering support obtained from the parent Standard Oil Co. (Ind.). Directing the work are J. E. Rouse and J. H. Forrester (see accompanying box). To implement the construction, the company has been carefully organizing a group of engineering experts on natural-gasoline processing, instrumentation, and the various chemical and mechanical phases thereon. Also set up have been carefully designed standards for gas handling and measurement, plant procedures, safety work and all the other allied phases of turning out natural gasoline and L.P.G. products.

In many of Stanolind's natural-gasoline plants, gasoline production is subordinate to oil-producing operations, and particularly so where

8 ACRES OF WATER FREE FROM ALGAE AND SLIME!



WITH A *Paddock* HIGH-CAPACITY CHLORINATOR

TOP PHOTO—*The eight-acre cooling pond of the Dallas Power & Light Company. In center background is the huge plant which helps furnish electric power for a half million people.*

LOWER PHOTO—*A D. P. & L. plant engineer adjusts the control valve of the Paddock High-Capacity Chlorinator which serves the big cooling pond.*

Chlorinating one hundred thousand gallons of water a minute!—that's the huge task efficiently handled by a single PADDOCK High-Capacity Chlorinator at the eight-acre cooling pond of the Dallas Power & Light Co., Dallas, Texas. The PADDOCK High-Capacity Chlorinator injects up to 1,000 pounds of chlorine a day to keep cooling equipment free from destructive algae and slime. Five giant steam condensers, total capacity of 67,500 square feet, are part of the vital machinery at the Dallas power plant protected by this efficient method of chlorination.

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studies of the reservoirs indicate that gas return to the producing formations will increase the ultimate recovery of crude oil. The same applies to cycling distillate reservoirs. Gas injection is being used in the plants now operating at Salt Creek (Wyo.), Luby (Tex.), Caddo (La.), Old Ocean (Tex.), West Edmond (Okla.). Underground gas storage is done at the Hastings plant. For those plants under construction, gas injection will be done at Elk Basin, Wyo., and cycling at Burnell-North Pettus. The pressure-maintenance, repressuring, and cycling operations are planned and executed under coordinated studies made with reservoir and production engineers to assure the maximum possible recovery of oil from each reservoir. That all of these foregoing programs represent very definite and purposeful contributions to the conservation of our petroleum resources —to the company and to the states and royalty owners concerned—is well understood by the oil industry.

Total gross production from all the gasoline and cycling plants that Stanolind is operating and has under construction, as to both full and partial interests, will somewhat exceed 1,000,000 gal. of products per day. When plant operations get into such a large scale as that, a wide variety of conditions are found, and a host of equipment of all kinds and sizes is involved. Some of the plants will receive sweet gas, some sour gas. Compressor horsepower will "bank" up to 25,600 at Slaughter. The Burnell-North Pettus cycling installation will take in as much as 166,000,000 cu. ft. of gas per day.

Stanolind's Elk Basin plant now under construction will be unusual in several respects. The gas is very sour and contains 18.5 per cent hydrogen sulfide. Stanolind will install a typical amine H_2S recovery unit and will then produce free sulfur. It is estimated that production of sulfur will amount to 59 long tons per day with the sulfur recovery decreasing as the gas is diluted through repressuring.

The Elk Basin plant will also include an inert-gas generator, which will produce a mixture of nitrogen and carbon dioxide for injection into the producing horizon. There is not sufficient methane produced for adequate repressuring and burning of the methane with air to make the inert gas mixture will provide almost three times as much gas for repressuring. Thus Elk Basin is a triple-header operation: natural-gasoline, sulfur production, and inert-gas generation.

In addition to the plants already announced as authorized or under construction, Stanolind is also investigating several other possible projects. It can be expected that Stanolind will announce definite plans for the construction of several more natural-gasoline plants to be built by 1950.

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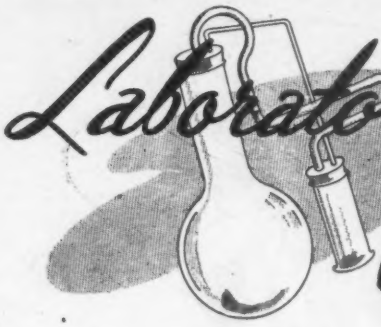

Laboratory Studies AND THEIR RELATION TO Cycling Problems

by J. P. Sloan*

THE procedures and data presented here provide the engineer with the story of condensate reservoir fluid behavior for a given operation. The article furnishes him with a basis for estimating recoveries by pressure depletion, cycling, or by a combination of the two. It provides him with a means of knowing beforehand, the quantities of gasoline hydrocarbons he will have to process through a gasoline plant, and the changes in these quantities as pressures decline, where this method of production is used. Knowing these things, the economics of cycling the reservoir as compared to production by pressure depletion may be properly evaluated.

THE first question to be answered for a new condensate reservoir is: How much? The determination of the extent of the reserve falls within the responsibility of the geologist and the driller along with the able assistance of the petroleum engineer. As soon as the extent of the deposit is known, or is sufficiently indicated, the next question is the availability of the deposit.

Once a hydrocarbon deposit is identified as being of the condensate type, or predominantly so, and is proved to be of commercial extent, the question of how to produce the deposit so as to secure the greatest return to the owners becomes of prime importance.

The reservoir may be produced by one of the following methods: **Pressure depletion,** which means simply to open the valve, and allow what will flow from the reservoir to come forth with an accompanying loss of pressure—or **to cycle** the contents of the reservoir maintaining the pressure, and recovering first its liquid components, then to produce the gas to the channels of commerce. Frequently a combination of these two processes is used because of the urgent need for some of the residue gas, the remainder being returned to the producing horizon.

The pressure-depletion method has the advantage of requiring the least outlay in producing and processing equipment. Its disadvantages are that it is the most wasteful, as far as the physical recovery of the deposit is

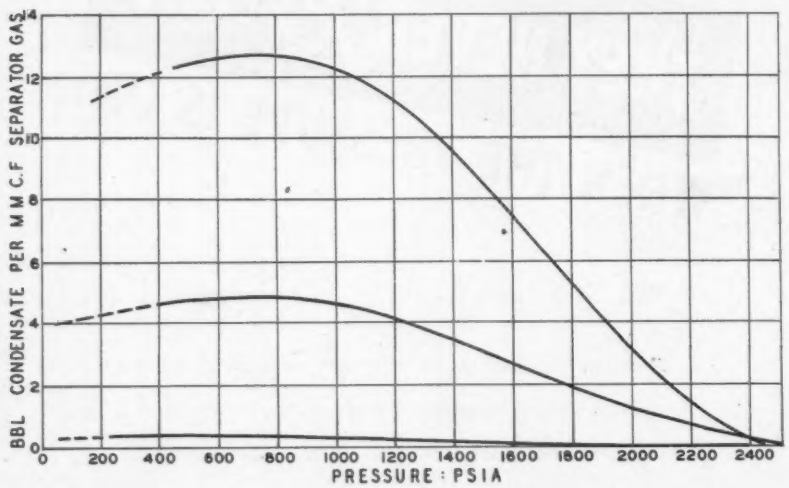

Fig. 1—Retrograde liquid loss of three samples containing 25 to 29 bbl. of isobutane and heavier hydrocarbons

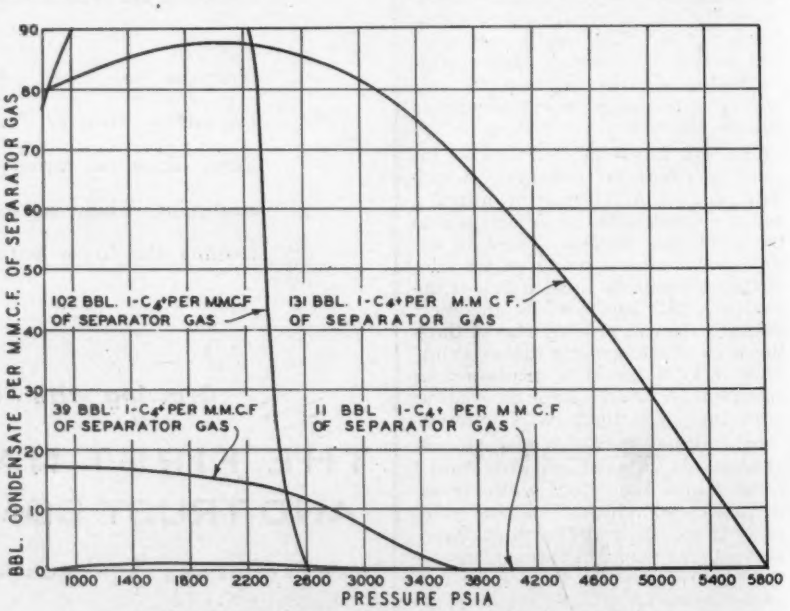

Fig. 2—Extreme examples of retrograde condensation

*Gulf Oil Corp., Houston.

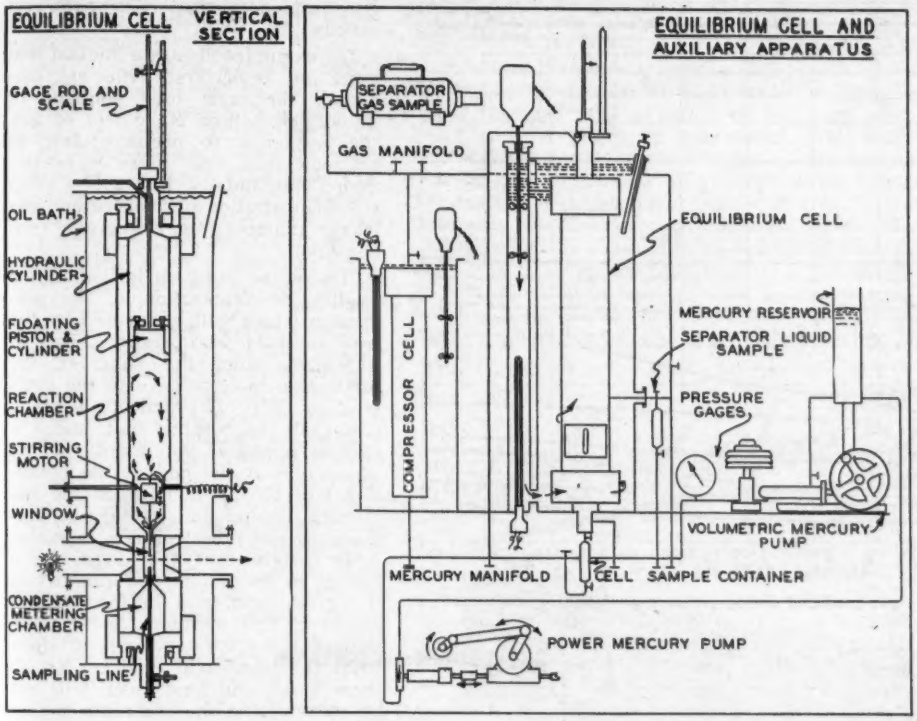

Fig. 3

concerned, and should the deposit be remote from a suitable market, it must remain dormant and unproductive.

Cycling has the advantage of effecting the maximum physical recovery of the deposit, and in the absence of a market for the gas, provides a source of current income from the investment until such a market develops. Its chief disadvantages are that it requires a considerable investment in compression and injection equipment, and for maximum efficiency, requires some form of unitization of the producing properties.

In weighing the question of cycling vs. pressure depletion, it becomes necessary to know the quantity and the quality of the production which can be secured by each of the two methods. It is at this point that the laboratory enters the picture. The time is not far past when gas was gas, and oil was oil, and the gloomy specter of retrograde condensation had not put in its appearance, and although untold millions of barrels of recoverable hydrocarbon liquids were irretrievably lost to the lease owners and to the consuming public, both were blissfully ignorant of this loss. Such is no longer the case. But here, again, the answer is not simple.

Fig. 1 shows the retrograde-loss curve of three reservoirs known to the writer, all of which produce between 19 and 21 bbl. of stock-tank condensate per million cubic feet of gas, or between 26 and 29 bbl. of isobutane and heavier hydrocarbons per million cubic feet of gas. Yet one of these reservoirs, if produced by pressure depletion, would lose more than 12 bbl. of condensate for each million cubic feet of virgin reservoir gas. Another would show a loss of less than 1 bbl. per million cubic feet of gas. The third curve (the center one) represents a more normal type of condensation.

To pursue the example, one reservoir containing 29 bbl. of I-C_4+ plus per M.M.c.f. of virgin gas would produce only 16 bbl. of this liquid at depletion, leaving 13 bbl. in the reservoir. The second reservoir, containing 26 bbl. of 1-C_4+ per M.M.c.f. of virgin reservoir gas would produce 25 bbl. of this by straight pressure depletion. The third sample, containing 22 bbl. of 1-C_4+ would produce 15 bbl., leaving 7 bbl. in the reservoir. This difference in retrograde loss is due to the difference in hydrocarbon composition and to the differ-

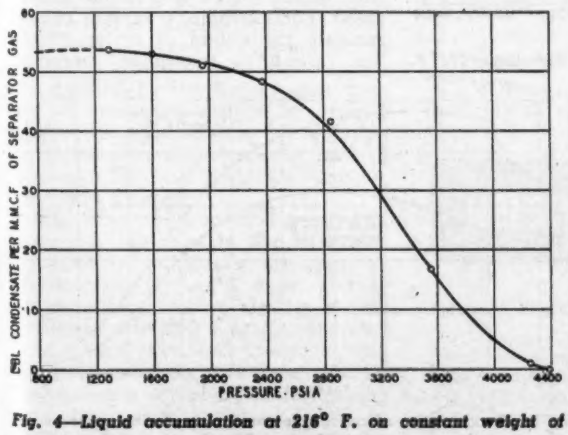

Fig. 4—Liquid accumulation at 218° F. on constant weight of reservoir fluid

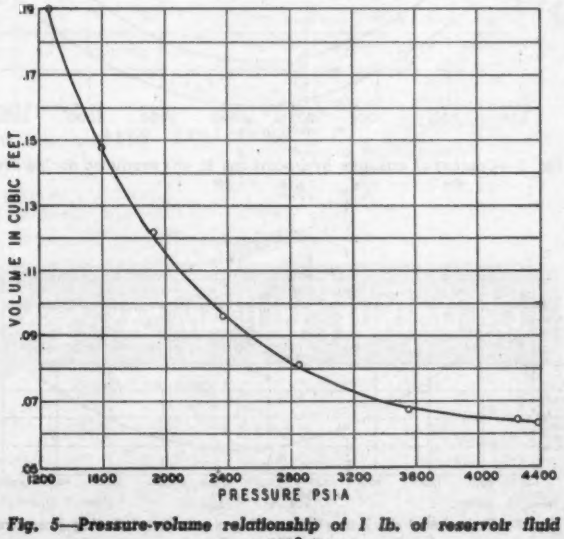

Fig. 5—Pressure-volume relationship of 1 lb. of reservoir fluid at 218° F.

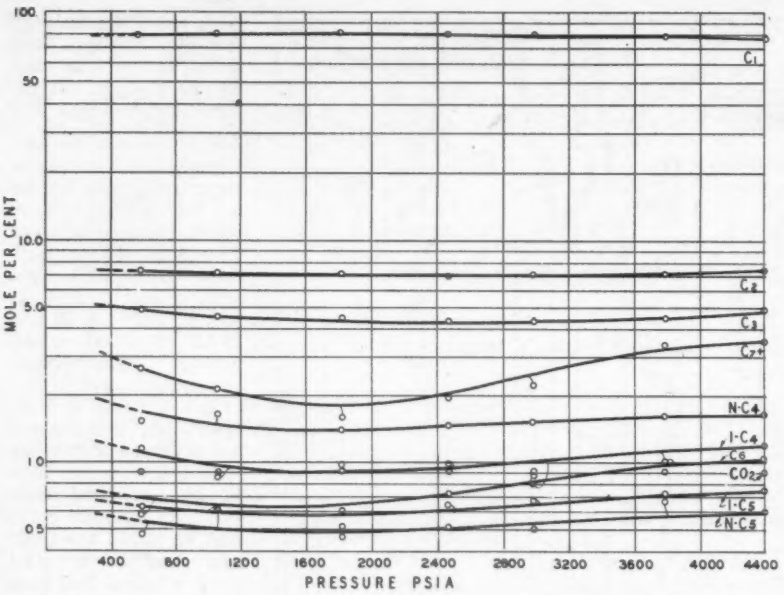

Fig. 6—Hydrocarbon analysis of gas produced during pressure depletion of cell at 216° F.

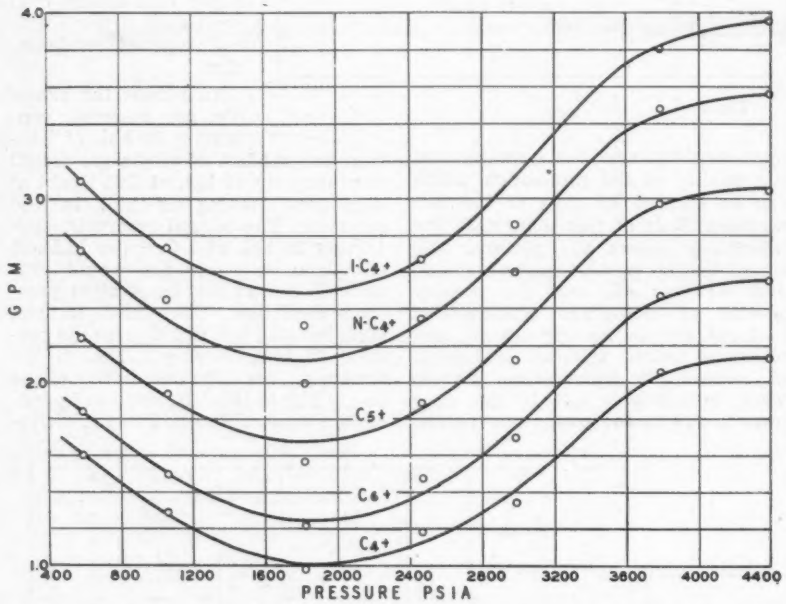

Fig. 7—Content of gasoline hydrocarbons in gas produced during pressure depletion at 216° F.

ence in physical properties of the reservoirs.

The examples illustrate the fact that even in reservoirs with approximately the same total contents of liquid per million cubic feet of gas, the responses to pressure drop is unpredictable, and must be determined individually. Fig. 2 is a composite illustration of average and extreme examples or retrograde condensation.

The second question is that of the quality, or composition, of the production which will be secured by the two methods of operation. This is important, since the value of the production is responsive to the composition. For all practical purposes, it is safe to assume that under a cycling program, the quality of the production at the end of the operation will be the same as at the beginning. Should the reservoir be produced by pressure depletion, however, it is certain that there will be a change in the quality and quantity of the production, and in the over-all recovery. This therefore, is the function of the laboratory: not to show what the plant will recover, but to show what, and how much will **not** be recovered if the reservoir is produced by the pressure-depletion method.

Reservoir Sample Requirements

Reservoir analysis actually begins with the preparation of the representative well for sampling. It is appropriate that something be said at this point about the meaning of the term "sample." Many, indeed, are the crimes that have been committed in the name of sampling. The requirements of a reservoir sample may be stated briefly here as follows:

A sample must be representative of the contents of the reservoir from which it comes. It must be capable of demonstrating all of the properties of the reservoir fluid. It must demonstrate these properties in their proper relationship. Samples have very definite limits, which should be understood. For example, a sample cannot indicate the extent of a deposit. In the case of a two-phase reservoir,

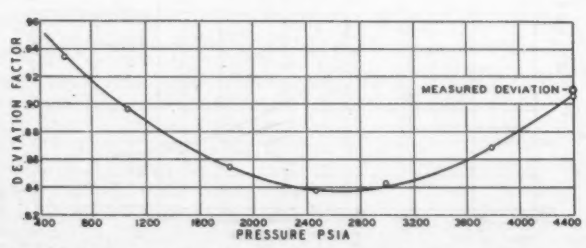

Fig. 8—Calculated deviation factor of gas produced during pressure depletion at 216° F.

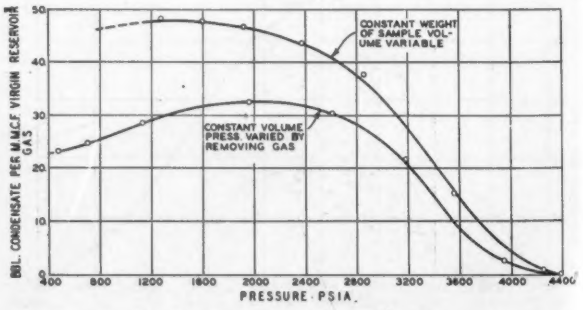
BBL. CONDENSATE PER M MCF VIRGIN RESERVOIR GAS
CONSTANT WEIGHT OF SAMPLE VOLUME VARIABLE
CONSTANT VOLUME PRESS VARIED BY REMOVING GAS
PRESSURE PSIA

Fig. 9—Accumulation of retrograde condensate during pressure depletion at 216° F.

containing both gas-phase and liquid-phase hydrocarbons, a sample cannot indicate the proportion of reservoir liquid to reservoir gas that exists underground.

So the sampling actually begins with the selection of the well. The sample well should be a good producer, completed within the main body of the reservoir, (the nearer the center the better), of as high productivity as possible, should exhibit average bottom-hole temperature and pressure, and should show an average gas-oil ratio. Any well which shows freakish tendencies of any sort, when compared to the other producers in the same reservoir, should be avoided. This also applies to wells which appear to be producing both gas and oil. This latter is a special case, which under certain conditions might produce usable samples, but should be avoided if there is any possible chance of sampling the two phases from separate wells whose production is coming wholly from these two respective phases.

Having selected the sample well, the static reservoir temperature and pressure should be secured as accurately as possible, and at a point as near the producing horizon as is practical. Minor deviations may be safely calculated by projecting the respective gradients where these are smooth. The well should then be opened up and produced at a rate sufficient to lift uniformly all of the liquids which condense between the reservoir and the well head. A rate of 3 to 5 million feet per day is usually satisfactory for wells of normal productivity. An excessive pressure drop from static to flowing conditions is highly undesirable, and should be avoided wherever possible. The well should be stabilized at this rate for 24 to 48 hours.

Stabilization is usually indicated by a levelling off of well-head temperature and pressure, a uniform gas-production chart, and a uniform accumulation of liquid in the separator and stock tank. When these conditions of uniform production have persisted for a long enough time to be convincing, an accurate gas-oil-ratio determination should be made. There are several ways of accomplishing this. The gas production, of course, is determined by the flow meter, with proper correction applied for gravity and supercompressibility. The liquid production must be on the basis of separator liquid at separator temperature and pressure.

The most direct method consists of accurately calibrating the separator between two marks as far apart as possible on the sight gage, and to measure with an accurate stop watch, the time required for the separator to fill from the lower mark to the upper one. Several checks should be made over a period of hours, or long enough for the successive checks to show consistent timing. When the conditions of production are stable, the average fill-up time of several runs is taken as representative, and from this average, the production for 24 hours is calculated.

One other system has been used in which the production of stock-tank liquid is gaged over a period of 24 hours, and the volume so determined then corrected to separator production by the application of a factor. This factor is determined from the difference in hydrocarbon composition between the separator and stock tank liquids, or by an experimentally determined shrinkage, secured by flashing a sample of separator liquid to atmosphere under carefully controlled conditions, and noting the volumetric difference between the liquid before and after flashing.

Having secured the ratio of separator gas to separator liquid, samples should be taken of the two separator phases. It is assumed, up to here, that the separator pressure has been stabilized at a point well below the retrograde pressure at the operating temperature. Approximately 800 psi. is the maximum pressure which is considered safe. This is important in the case of the separator gas since the sampling of any gas stream which is composed of two phase, or which, during subsequent handling in the sample container, might be changed

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from single phase to the two-phase condition, complicates tremendously the problem of securing a good sample in the first place, and of transferring representative portions of the sample to the equilibrium cell in the second place. However, if the gas has been separated at or below the aforementioned maximum pressure, it may be considered safe from any condensation whatever within the container due to loss of pressure from leakage, or from withdrawals of portions for any of the analytical procedure, or from any minor temperature drop. Where the separator temperature itself is low, it is desirable to lower the separator pressure since the low temperature (50° F. or lower) induces a lower maximum retrograde pressure in the well stream.

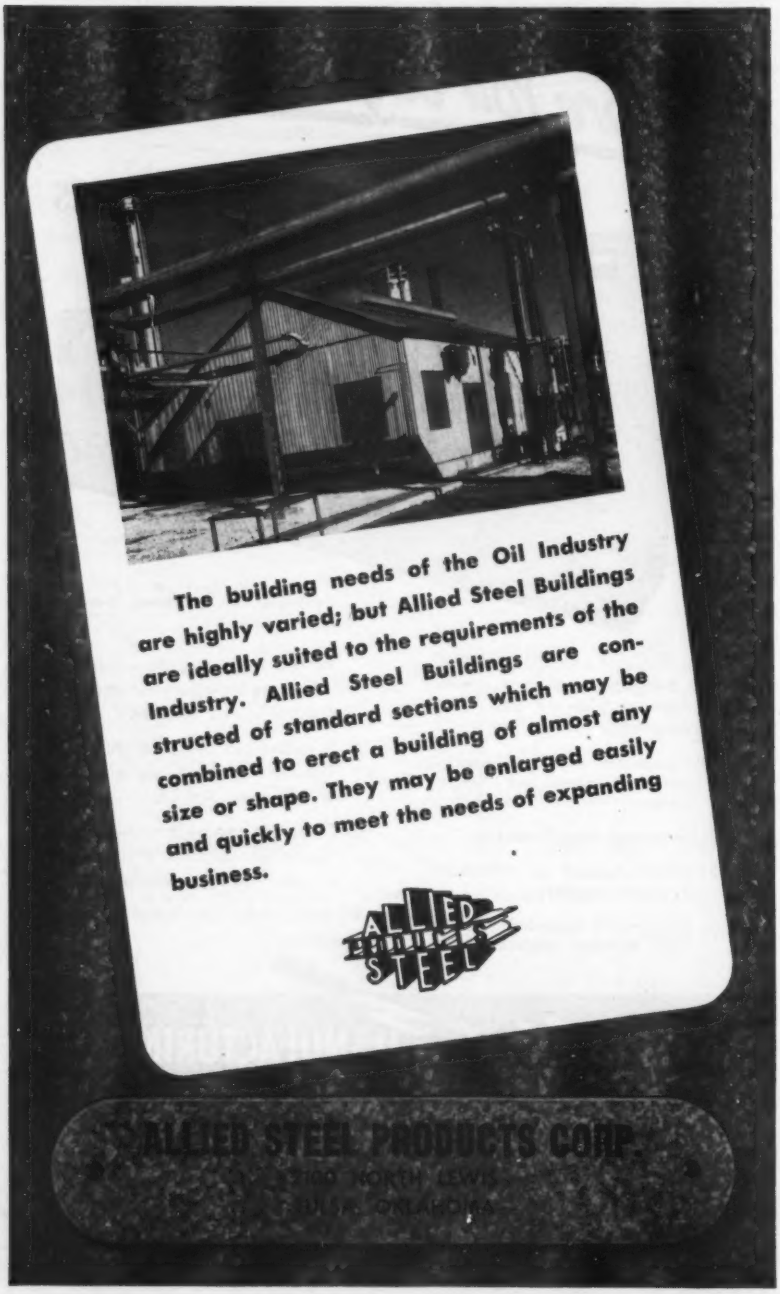
With the foregoing precautions, the gas sample may be taken by the simple purging of clean sample containers with gas from the meter run, or other suitable tap, for a period long enough to displace several times the volume of the container, then closing the outlet valve on the sample container and allowing the pressure to build up to full separator pressure. Should additional precaution be deemed advisable, the pressure of the sample container may be lowered 25 to 50 psi. by venting gas to the air, which will serve as an additional barrier to condensation. The liquid sample may safely be taken by the upward displacement of air or gas in the container, followed by a slow purging of liquid from the top valve, while the bottom valve, and the line connecting the container with the separator are wide open, and the system to the purging valve is under full separator pressure. In this manner from four to six volumes of liquid are washed through the container, following which the upper, then the lower valves in turn are closed.

If the containers are very heavy walled, and of just a few hundred cubic centimeters in volume, they safely may be left completely full of liquid. However, the larger-size containers should be provided with a minute gas bubble for safety in case of expansion of the contents should the container be warmed above the temperature of sampling. This may be done by quickly bleeding a thimble full of liquid from the bottom valve of the vertically supported container.

Duplicate Samples

Any samples to be used for reservoir analysis that are worth taking at all should be taken in duplicate as a minimum, and where possible, in triplicate. It costs very little more to fill additional containers, and after spending perhaps several hundred dollars stabilizing and testing a well, the investment should by all means be safeguarded by taking a sufficiently large sample for the anticipated analysis, with enough left over for checking the results if necessary, then taking this sample in duplicate or triplicate to insure against possible loss due to a leaky valve, accident in handling, or in failure during analysis. The sample containers used by the writer are of approximately 5 gal. capacity for the gas sample, with a test pressure of 1,500 to 2,000 psi. which permits 800 psi. working pressure with ample safety factor. The liquid containers are of 600 to 1,200 cc. with a test pressure of 3,000 to 5,000 psi.

It is a common practice of many engineers to take separator liquid and gas samples of the same volume. This results in either a huge surplus of liquid, or in a scarcity of gas. The apparatus to be described in connection with this study requires from 6 to 9 cu. ft. of separator gas at atmospheric conditions for an average charge. For a 90-bbl.-per-M.M.c.f. condensate ratio, thus requires approximately 100 to 150 cc. of liquid. At 800 psi. separator pressure, this gas sample occupies 1 to 1.5 gal. of sample space. Thus, for this very rich condensate the ratio of liquid sample to gas sample is of the order to 10 to 1 after increasing the amount of each by enough for hydrocarbon analysis.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This is quite different from the 1 to 1 volumes frequently seen.

The writer has recently had opportunity to observe a set of condensate companion samples in which the gas volume amounted to approximately 5 cu. ft. total volume (atmospheric conditions) and the liquid sample amounted to nearly 2 gal. This sample had been taken in a foreign country, and brought across the ocean by the production superintendent. Needless to say, the slightest error or accident in transportation, or in transfer to the apparatus, or in the operation of the apparatus would have completely nullified the expense of testing, sampling, transocean transportation, and any work which may have been done on the sample.

Mention has been made of the apparatus[1,2] used in these studies of condensate behavior. Fig. 3 is a diagram of the cell with its principal auxiliaries. The volume and range of the present cell have been increased over the original version, in order to care for the increased pressures and temperatures presently encountered, and it is capable of working pressures above 8,000 psi. and temperatures somewhat in excess of 300° F. Provision has also been made for excessive volumes of liquid-phase material, where the gas-oil ratios are low, or to enable a proper conclusion to be reached where the production under test proves eventually to be a combination of reservoir liquid and reservoir gas.

Principal feature of the cell is a floating piston for varying the cell volume, in connection with a double window for viewing the gas-liquid meniscus, and for measuring the volume of the equilibrium liquid by observing the movement of this meniscus and the liquid-mercury interface when they are moved past an index marker by means of a calibrated mercury-displacement pump. It will be noted that the large diameter of the cylinder bore in which the piston travels is reduced from 4 in. to ½ in. in the window section of the cell. Thus, by reducing the cross-section area of the portion of the bore occupied by the liquid phase, the length of the resulting column is greatly increased, making the reading of the resulting points more accurate.[3]

Operation of Cell

Operation of the cell is such that wetting of the entire inner cell surface, and the resulting liquid holdup, is avoided wherever possible. The ground and polished inner surface also aids in reducing this holdup where it is impossible to avoid wet walls. Stirring of the charge is accomplished by means of a miniature electric motor totally enclosed within the lower portion of the cell bore, immediately above the observation window section. This motor is an especially hand-tailored motor of the shaded-pole type, with a double-end shaft rotating in high-speed ball bearings.

Upper end of the shaft carries a six-blade turbine-type fan which draws the gas into the center of rotation, and throws it out at right angles to the axis of rotation. A deflector directs about half of this stream downward along the wall of the motor chamber, and directly across the surface of the liquid phase, then up the other side and into the gas space above the motor. Lower end of the shaft carries another turbine blade hung immediately above the normal liquid level, and a third propeller-type stirring blade in the upper portion of the liquid which adds to the turbulence of the two phases at the interface. This shaft extends down into the observation window, and carries a tiny ⅜-in. diameter screw-type propeller, with the shaft itself wrapped spirally with a spring wire at the approximate pitch of the propeller. This gives a vigorous agitation of the liquid in the window section, and at the same time a rapid top to bottom circulation of the liquid. With an average condensate, this type of contacting will produce equilibrium between gas and liquid

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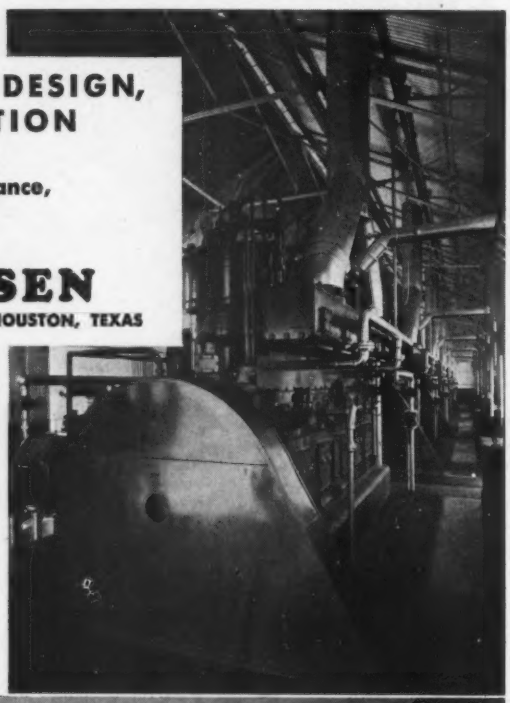
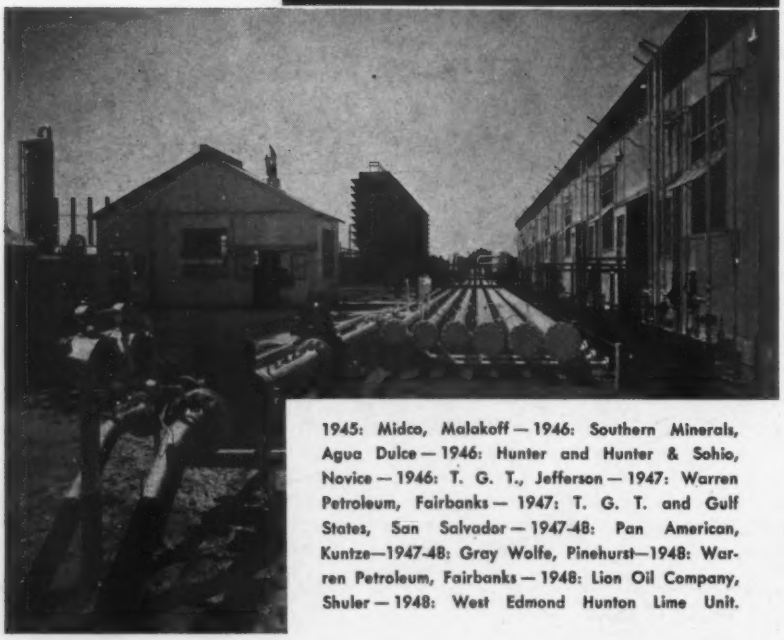


Warren's pressure maintenance plant, Fairbanks, Texas



1945: Midco, Malakoff — 1946: Southern Minerals, Agua Dulce — 1946: Hunter and Hunter & Sohio, Novice — 1946: T. G. T., Jefferson — 1947: Warren Petroleum, Fairbanks — 1947: T. G. T. and Gulf States, San Salvador — 1947-48: Pan American, Kuntze—1947-48: Gray Wolfe, Pinehurst—1948: Warren Petroleum, Fairbanks — 1948: Lion Oil Company, Shuler — 1948: West Edmond Hunton Lime Unit.

phases in from 8 to 16 hours, after a pressure increase of 500 to 800 psi. Equilibrium conditions are indicated by static pressure and liquid volume with the cell volume and temperature being held constant.

The principal auxiliaries are a thermostatically controlled oil bath with control equipment; an oil-jacketed compressor cylinder which is a vertical straight-walled cylinder with coned ends for drainage, and with a tubing connection to the mercury manifold at the bottom cone, and a tubing connection to the gas manifold at the top cone; a power pump for handling bulk volumes of mercury as in compressing the gas charge into the cell, and in the moving of the piston to change the volume of the cell; a calibrated volumetric mercury pump for measuring the liquid-phase volume and for injection of the separator liquid sample; a combination of dial and piston gages for pressure measurement; and a control panel for electrical controls and indicating pilot lights. A low-temperature fractionating column is essential.

The laboratory work proper begins with the hydrocarbon analysis of the separator samples, and the mathematical recombination of these analyses in the separator ratio to give the composition, and subsequently the weight and theoretical gas volume of the cell charge. The apparatus is prepared for service by moving the floating piston to the top of the cylinder, then spraying the interior thoroughly with petroleum ether saturated with natural gas at 300 to 500 psi., draining the ether, and repeating until the drainings show no oily residue on evaporation, followed by evacuation of the cell to remove the last traces of the ether. The compressor cylinder is prepared in the same manner.

If there is any chance that condensation has occurred in the gas-sample container, this container is heated in a suitable stove, or water bath, for several hours prior to use. The equilibrium cell is then filled with separator gas to the full pressure of the gas-sample container, after which the compressor cylinder is filled to the remaining sample pressure. The power mercury pump is then placed in operation, pumping mercury into the bottom of the compressor cylinder.

As soon as the compressor is at or above the cell pressure, the valve between them is opened, and the total content is displaced into the cell. The compressor is then emptied of mercury by blowing it back into the reservoir by gas from the sample container, and the cycle repeated a sufficient number of times properly to charge the cell.

If the sample container is of the size mentioned (5 gal.) and is pressured at 600 to 800 psi., one cycle of the compressor is sufficient to build the cell to an initial pressure of 1,000 to 1,500 psi., and requires approximately 1 hour for the charging procedure. If, however, the sample comes in at 100 psi., and the volume is smaller, it may require from 15 to 25 cycles of the compressor, and 2 full days of work to build the cell charge to the proper pressure, due to the small quantity of gas that is involved in each stroke of the pump, and as the sample pressure declines with each cycle, the quantity in the next cycle is still further reduced.

As soon as the cell has been charged with sufficient gas sample an observation is made in the window to ascertain if any condensation has been caused by the compression of the gas. This is very significant, because the presence of any liquid at this point will proportionately affect the determination of the quantity of the charge. If condensation is indicated, the stirring motor within the cell is started, and the oil bath is heated until the sample is again in the gas phase. As soon as the temperature is constant, a measurement is made of the deadweight pressure, the accurate temperature, and the volume of space occupied by the sample, as observed from the scale and gage-rod index at the top of the cell.

The deviation factor of the gas is then determined in the following

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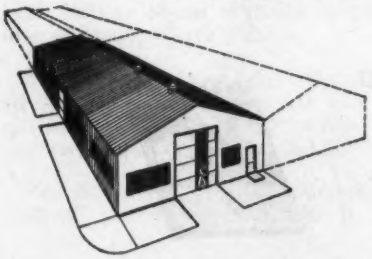

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manner. The compressor cylinder is heated to the cell temperature, and is charged with the separator gas to a pressure of from 5 to 10 psig. After the establishment of thermal equilibrium, the absolute pressure of the sample is measured by means of a mercury manometer and a mercurial barometer. By the application of the gas laws to this low-pressure sample the volume at 60° F. and 14.65 psia. (or any other desired base) is calculated. This determined volume is then compressed by pumping mercury into the compressor cylinder with the power pump until the pressure of the gas is approximately equal to that of the cell charge. After carefully adjusting the temperature to the charging temperature of the cell, the hand-operated volumetric pump is used to balance the pressure to that of the cell, using the deadweight gage as a reference. The dial reading of the volumetric pump is then recorded, the compressed gas sample is displaced to the atmosphere, the pressure on the mercury-filled system then adjusted to the same deadweight pressure, and the pump dial is again read. This procedure gives the actual volume at the charging temperature and pressure of a known volume at standard conditions, avoiding the necessity for extensive calculations of differential mercury volumes at various temperatures and pressures. The volume at standard conditions of the cell charge is readily determined by multiplying the ratio of the cell volume to the compressed test volume by the standard volume of the test sample at standard conditions.

With the volume of the gas charge determined, it is a simple matter to calculate the required volume of separator liquid to match the gas-liquid ratio of the well stream. This calculated volume of liquid must then be corrected for any difference which might exist between the temperature at the time of measuring the separator, and that existing at the time of charging.

The coefficient of expansion may be satisfactorily determined from the hydrocarbon analysis by means of the liquid gravity-thermal expansion table in common use. There is also a correction which must be made for the compressibility of the liquid. This is determined by making a simple compressibility determination on the sample container used in the charging procedure, first full of mercury, then with a known volume of the separator liquid, calculating the compressibility per cubic centimeter of the liquid and applying the factor directly to the calculated volume of separator liquid required for the gas charge. This corrected quantity is then displaced by the volumetric pump from the charging container into the equilibrium cell. The resulting mixture within the cell is then equivalent, in its over-all composition, to the well stream, within the limits of the accuracy of the measurement of the well-stream gas-oil ratio.

The temperature of the cell oil bath is now adjusted to the reservoir temperature of the sample, and the enclosed stirring motor is put into operation. It has been determined experimentally that the time required for the initial establishment of equilibrium is somewhat longer than for the subsequent determination, frequently requiring in excess of 30 hours. This is due to two probable factors, namely: the proportionately great changes in composition required before the separator-composition samples have adapted themselves completely to the new conditions of pressure and temperature; and to the fact that the cell volume is greatest at this point, therefore reducing the frequency of contacting all of the liquid with all of the gas. In order to avoid a presumptive error, this initial contact period is maintained for a period of 48 hours. Toward the end of this period the volume of the liquid phase is measured by displacement, using the volumetric pump as the means of determination. This is done as follows: the mercury-oil level is pulled down into the mercury chamber by backing off the piston of the volumetric

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pump until the liquid-gas meniscus is below the zero index mark. (See Fig. 3.)[3]

In case the liquid volume is large enough materially to affect the pressure by its withdrawal below the index, the piston is simultaneously moved downward an equal volume in order not to upset the equilibrium during measurement. The volumetric pump is then reversed, and the gas-liquid meniscus is moved slowly upward until it is exactly opposite the index mark, and the dial on the pump is read to the nearest 0.01 cc. Movement of the pump hand wheel is resumed, and mercury is displaced into the cell mercury chamber until the oil-mercury meniscus is exactly opposite the abovementioned index mark, after which the pump dial is again read.

The difference in these two readings represents the displacement volume of the liquid, subject first to a correction derived by consultation of a calibration chart for the cell. This is necessary because of the capillary wetting of the walls in the window section by the hydrocarbon liquid. When successive readings of the liquid volume, taken 2 hours apart, check to within 0.02 cc., equilibrium is presumed to be established.

With the establishment of equilibrium between the gas and liquid phases, observations are made of the deadweight pressure, and the liquid volume is recorded. Total volume of the cell is observed from the index and scale at the top of the cell. The pressure is raised to a point from 300 to 800 psi. (depending upon the nature of the sample, and to the location on the curve) by pumping mercury into the chamber above the piston, forcing the floating piston down the cylinder, thereby reducing the volume occupied by the charge. At the end of 24 hours another observation is made of the above three values. This procedure is repeated until reservoir pressure is exceeded. As the trend of liquid volume begins to approach the dry point, more frequent observations are made, so as to properly define the retrograde ("liquid accumulation") curve (Fig. 4) and to properly locate the dew point of the mixture. The usefulness of this procedure will be discussed later in this article.

As the reservoir pressure is reached by the cell charge, there are two possibilities: either the charge has reached, or passed through the dew point and has become a homogeneous dry gas; or there is a liquid residue, indicating that the charge to the cell does not represent a single-phase reservoir. It is proper to discuss this possible development at this time. The presence of liquid at the reservoir temperature and reservoir pressure may indicate any one of several possible interpretations. The first of these is that the samples are not representative of the well stream. For instance, if there has been any leakage of material from the liquid sample container, it is quite possible that this leakage will not be average composition liquid. If the leakage has occurred from a loose thread, or a scored valve seat at the top of the cylinder, the material lost will be largely from the expansion gas cap if such has been provided, or if none is present the leakage will create one. This material is composed of much lighter hydrocarbons than the average of the original single-phase liquid. The loss of a part of these light hydrocarbons then leaves a sample with a higher average molecular weight than the original.

A recombination of this heavier liquid sample with the separator gas in the correct separator ratio therefore results in an over-all sample composition heavier than the well-stream composition, and will most certainly leave a liquid residue at reservoir conditions if the reservoir gas was originally saturated. The quantity of this residue liquid will be in proportion to the quantity of light ends lost from the sample. A simple check of the bubble-point pressure of the material in the liquid-sample container at separator temperature just prior to use furnishes a convenient

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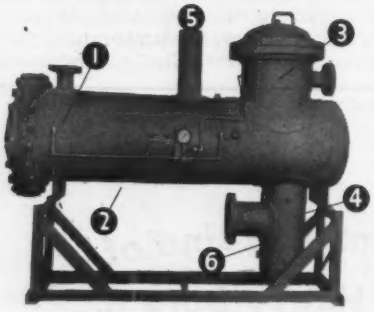

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means of determining the usability of the sample. An incorrect ratio determination may tend to have this effect also, or if the error is on the high side, will lower the entire curve.

A second possibility may be in the well production itself. If the well is not properly stabilized at the time of the sampling, erratic results are to be expected. Some wells prove very difficult to stabilize, due to tightness in the sand face, or other conditions which would cause an unusual drop in the flowing pressure when production is great enough to lift uniformly all of the liquids. (This is the reason for the stipulation earlier that the well selected be a good producer.) Condensates vary widely in their sensitivity to the first 25 to 50-lb. drop in pressure, depending entirely on the composition.

The writer has seen condensate which would precipitate liquid at the rate of 1 to 2 bbl. per M.M.c.f. of gas in the first 10-lb. drop in pressure. Other samples have been known to precipitate only a very few gallons of liquid per million cubic feet of gas in several hundred pounds of pressure drop. In the first case, any significant pressure drop around the bottom of the well bore will result in the eventual saturation of the nearby sand, which in effect, creates a two-phase condition around the well bore where, perhaps, none existed before. It is entirely possible, in this case, for slight changes in production conditions to entrain a portion of the liquid which was precipitated from earlier production. The effect of this would be to extend the liquid accumulation curve, and of course, its terminus (which is the dew point) considerably beyond the reservoir pressure, although the magnitude of the liquid residue would likely be relatively small.

Another possibility is that the production entering the well bore from the reservoir is a combination of reservoir gas and reservoir liquid, indicating that the reservoir is in fact a two-phase reservoir. In most cases of this kind, the liquid residue in the cell at reservoir temperature and pressure is dark in color, with much the appearance of an average crude oil. The quantity of this residue may be small, or great, depending entirely upon how much of the reservoir liquid (crude oil) has been produced along with the saturated reservoir gas. This indication of the presence of some unknown quantity of crude oil in the reservoir is of major importance in itself. Certainly it would influence the development procedure to the extent of exploring the possibility of developing the oil potentialities of the field, as well as the condensate reserve.

What other information may be secured from such a combination sample is still the subject of considerable

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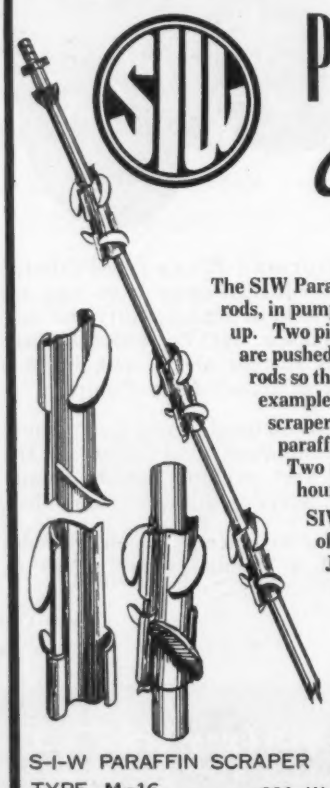

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discussion among authorities on the subject. The writer has recently been convinced by one of them that the equilibrium oil and gas phases at reservoir conditions of such a sample are representative of the corresponding reservoir phases if the two phases as they enter the well bore are of **reservoir equilibrium composition.**

Most production men are familiar with oil wells with an original gas-oil ratio of 1,000 to 15,000 cu. ft. per barrel, which ratios begin to increase almost immediately, and continue to increase during production until the weekly or monthly allowable has been produced, and which after a shutin period repeats this performance, sometimes duplicating the range, but as often as not starting at a different ratio, and ending the producing period at still another. Is it possible that these reservoir phases are in equilibrium throughout a run of this kind? It is the writer's opinion that such a well should be avoided, and that once the two-phase condition in the reservoir is established, it is much better, if at all possible, to select two wells, one producing only reservoir gas and condensate, and the other producing only reservoir oil with its solution gas, then sample and evaluate each without the interference of the other. For the remainder of this discussion, it will be assumed that the subject sample, at reservoir temperature and pressure, is a dew-point sample and indicates a single-phase gas reservoir.

Having established the dew-point condition, and in so doing having secured the P.V.T. data on the cell charge (Fig. 5), the cell with its charge is now, in effect, a small-scale reservoir, containing a quantity of the single-phase reservoir fluid of the same composition as the original reservoir, and under the same conditions of temperature and pressure. The sample occupies the same relative volume as would be required in the reservoir itself. Thus, at this point we have the reservoir volume factor of a known weight and composition of reservoir fluid.

As mentioned earlier, it may be safely assumed that if this reservoir is produced by cycling before the commercial use of any of the gas, all of the liquids in place in the reservoir will be produced to the surface, and may be recovered by separation and absorption, to a degree subject to the displacement efficiency of the cycling operation and the slight drop in pressure due to extraction of liquid components, and to the use of a portion of the tail gas for fuel.[5]

This brings us to the question of how much will be lost if the contents of the reservoir are not cycled, and the pressure is allowed to drop as the result of withdrawals of gas. In the final analysis, as far as the laboratory is concerned, this is the im-

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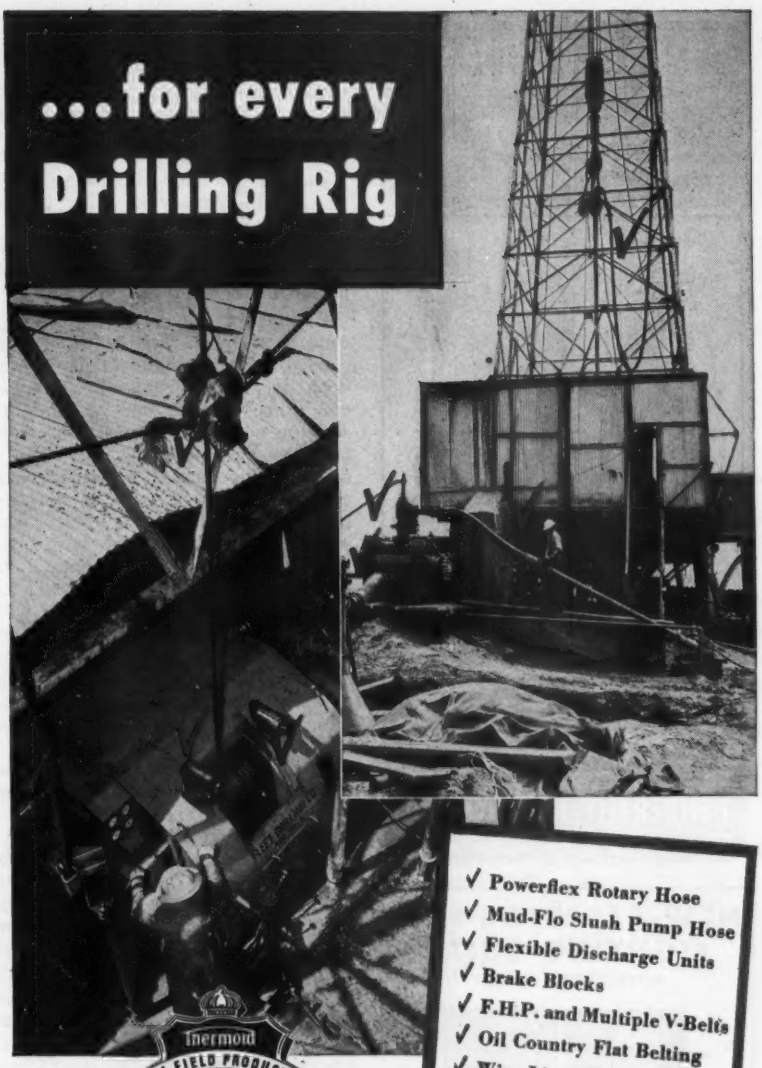

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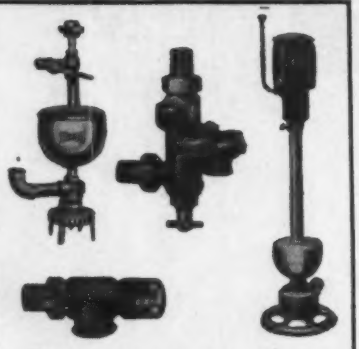

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portant factor in the decision of whether to cycle, or to produce the reservoir by pressure depletion. The method of approach is to duplicate, in the laboratory equipment, insofar as physical limitations will permit, the procedure which would be followed in the actual pressure depletion of the reservoir, with the advantage that the actual behavior of the sample may be observed, and the total procedure followed through in a period of days instead of years.

In the previously described procedure, the composition of the cell charge has been determined, together with its reservoir volume, and phase condition. These data furnish the starting point for the last four of the curves. These curves are: Fig. 6, showing the change in mol percentage occurrence of each of the components in the produced gas as the pressure declines; Fig. 7, which is a presentation of the same data in the form of g.p.m. contents of the I-C_4+ components in the produced gas; Fig. 8, showing the effect of pressure decline and its corresponding composition change upon the deviation factor of the reservoir gas phase; and Fig. 9, which shows the accumulating volume of actual retrograde liquid, at reservoir temperature, and including the dissolved methane, ethane, and propane which are in the I-C_4+ liquid by solution due to the prevailing pressure. These curves are discussed in detail later in the article. The succeeding points are secured by a series of pressure drops, observation, and the taking of samples for analysis.

The procedure is as follows: The cell pressure is lowered by venting gas to the air. The magnitude of the drop is governed by the original reservoir pressure, and the quantity of the cell charge. Normally, six to eight points are considered ample for a determination, and evenly spaced, will produce pressure intervals of from 400 to 800 psi. Since approximately the same atmospheric volume of sample is used for each hydrocarbon analysis, there is more gas to be blown down between samples on a high-pressure reservoir than would be the case for a low-pressure reservoir.

The reduction of the cell pressure by the venting of gas is one of the more critical procedures (if, indeed, one link in a chain might be considered more critical than another) in the entire operation, since an error here not only means an incorrect analysis of the immediately following sample, but of **all** of the subsequent samples, and all of the interpretations secured therefrom! The reason is much simpler than the solution. As soon as the pressure on the confined gas is reduced by the initial venting of gas, the remaining gas within the cell begins to undergo retrograde-pressure condensation, and the formerly homogeneous gas becomes a suspension of microscopic liquid droplets in the gaseous medium.

The droplets properly belong in the accumulating volume of retrograde liquid at the bottom of the cell and given time, will find their place there. However, if the gas being vented is allowed to escape at too rapid a rate, a considerable quantity of this fog which belongs in the retrograde liquid is mechanically carried out by the gas stream. Thus, while present in the original charge, it would not show up in the precipitated liquid where it belongs, nor in the analysis of the gas, where it does not belong, unless the sample to be used for anal-

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ysis were to contain, by some fortunate accident, the same relative quantity of fog. However, this "fortunate" accident, should it occur, would not correct the error, although it would aid in the subsequent material balance check, for then, the analysis of the gas would be deceptively high in gasoline components.

When the pressure within the cell has been lowered to the first sampling pressure (in the example cited,[8] the pressure in this first step is lowered from 4,393 to 3,947 psia., or 446 psi.), over a period of approximately 7 hours, the cell is allowed to drain overnight. This is to allow as much as possible of the precipitated liquid which has wet the inner walls of the cell to drain into the bottom of the cell where it can be measured. After the period of drainage, the cell pressure is accurately determined, the temperature of the bath is checked to see that it is still at reservoir temperature, and the cell volume is checked as a precaution against leakage of mercury around the gage-rod packing gland. The volume of the retrograde liquid is determined by displacement with the volumetric pump, as described earlier, the data being carefully recorded.

The gas-phase portion of the residual charge in the cell left from the above pressure-drop procedure, is now sampled for hydrocarbon analysis. The same precautions are followed in the sampling as in the venting of gas, the only difference being that the size of the sample taken (by the displacement of mercury from a previ-

TABLE 1
Equilibrium Phase Relationship of Sample, With the Temperature Constant at 216° F. and the Weight of Overall Composition of the Sample Constant. Pressure and Volume Variable

Cell pressure (psia.)	Liquid phase volume (cc. observed)	Liquid phase volume bbl. per M.M.c.f. separator gas
1,267	56.25	53.32
1,597	55.63	53.22
1,915	54.40	52.05
2,365	50.53	48.40
2,847	43.55	41.72
3,557	17.58	16.82
4,255	1.16	1.11
4,393	0.00	0.00

TABLE 2
Pressure-Volume Relationship of 1 Lb. of Reservoir Fluid (Recombined Well Stream) at 216° F.

Cell pressure (psia.)	Volume of sample in cc.	Volume in cu. ft. occupied by 1 lb. of sample
1,267	2,673	.190
1,597	2,085	.148
1,915	1,715	.122
2,365	1,375	.096
2,847	1,147	.081
3,557	944	.067
4,255	828	.059
4,393	816	.058

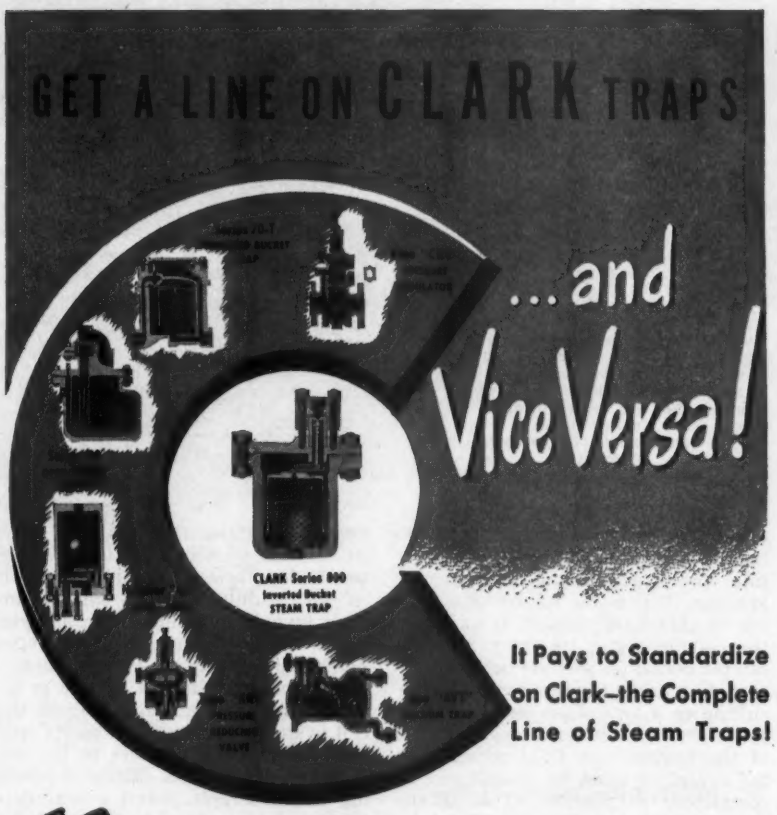

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TABLE 3

Column 1 Pressure (psia.)	Column 2 Operation performed	Column 3 Residual liquid (cc.)	Column 4 Residual liquid bbl./M.M.c.f. of virgin reservoir gas
4,393	Observation	0.00	0.00
4,393 to 3,947	Gas vented to air		
3,947	Observation	3.20	2.76
3,947 to 3,622	Sample for analysis		
3,622 to 3,184	Gas vented to air		
3,184	Observation	25.10	21.63
3,184 to 2,776	Sample for analysis		
2,776 to 2,607	Gas vented to air		
2,607	Observation	35.27	30.39
2,607 to 2,317	Sample for analysis		
2,317 to 1,959	Gas vented to air		
1,959	Observation	37.74	32.52
1,959 to 1,675	Sample for analysis		
1,675 to 1,125	Gas vented to air		
1,125	Observation	33.18	28.59
1,125 to 991	Sample for analysis		
991 to 699	Gas vented to air		
699	Observation	28.82	24.83
699 to 462	Sample for analysis		
462	Observation	27.24	23.47
462	Residual liquid sampled for analysis		

ously filled container) is controlled so that it may be discharged completely into the fractionating column for analysis. Due to the nature of a sample of this kind, though it exists in the cell as a gas, its entry into the sample container permits both a pressure drop and a temperature drop, resulting in a two-phase sample. Consequently, to secure a correct analysis of the sample, the total contents of the container must be transferred as completely as possible. This is another of those "most critical" points, any mishandling of which will result in the loss or damaging of the sample, and a misleading analysis. Error in the handling of these samples almost invariably results in an analysis which is low in the gasoline components, particularly the C_7+ fraction.

As soon as sufficient sample is secured, the transfer of gas from the cell is stopped for approximately half an hour, and the pressure in the cell is again determined. Since the taking of the sample is but a continuation of the pressure depletion of the cell, accompanied by a corresponding pressure drop and composition change in the gas-phase portion of the cell charge, the material in the sample taken for analysis is a composite of the composition throughout this pressure change. Consequently, in the example, the analysis of this sample is attributed to the average pressure prevailing during the sampling period. This applies also to all of the information derived from the sample itself, such as gasoline content (Fig. 7) and deviation factor (Fig. 8). Upon completion of the sampling, the venting of gas is resumed and the cell pressure is lowered to the next observation pressure.

The cell is thus depleted in six to eight steps to atmospheric pressure, or to some approximate depletion pressure near the 500-psi. range.

The following is an example, in tabular form, of the procedure and the data secured from the analysis of a typical gas-condensate reservoir,[3] together with the necessary conversions of these data to field terms.

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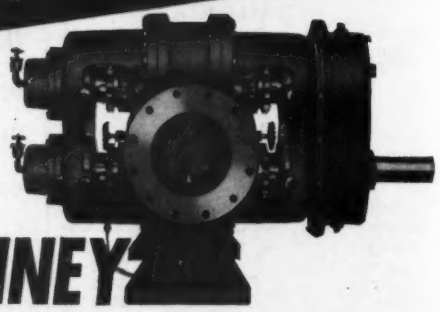

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Manganese	0.75
Chromium	19.50
Nickel	10.00
Molybdenum	2.25

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Tensile Strength	82,000
Yield Point	42,000
Elongation in 2"—%	50
Brinell Hardness	160

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Separator temperature—40° F.

Separator ratio—
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1 M.M.c.f. gas at 60° F. and 14.65 psia.

Reservoir conditions:

Pressure, psia.	4,393
Temperature, °F.	216

HYDROCARBON ANALYSIS OF SEPARATOR SAMPLES WITH MATHEMATICAL RECOMBINATION IN PRODUCED RATIO TO GIVE WELL-STREAM COMPOSITION

	Separator gas mol	Separator liquid		Well-stream
Component	(%)	Mol (%)	Liquid (%)	Mol (%)
CO_2	1.00	....	....	.90
C_1	85.24	12.65	5.31	78.05
C_2	7.44	7.35	4.33	7.42
C_3	4.02	12.65	8.60	4.88
$I\text{-}C_4$	.71	5.54	4.48	1.18
$N\text{-}C_4$	.82	9.16	7.15	1.65
$I\text{-}C_5$	.22	5.54	5.02	.75
$N\text{-}C_5$	.15	4.70	4.21	60
C_6	.21	8.55	8.71	1.04
C_7+	.19	33.86	52.19	3.53
	100.00	100.00	100.00	100.00

PROPERTIES OF C_7+ RESIDUE FROM SEPARATOR LIQUID ANALYSIS

Specific gravity	.7936
°A.P.I. gravity	46.8
Molecular weight	144

Fig. 4 is a graphical presentation of these data. This curve serves two purposes. The first is to set forth the condensation characteristics of the reservoir fluid, and in this capacity, serves as a means of checking the pressure depletion curve to be discussed later. The second, and specific function of this curve is to properly identify and fix the saturation pressure, or dew point pressure. At the same time that the data in Table 1 are secured, the pressure-volume relationship is determined in the manner described in Table 2.

These data serve the function of providing the reservoir volume factor of a known weight and composition of reservoir fluid. This, in connection with the volumetric data of the reservoir, is of use in the calculation of the gas and liquid reserves of the reservoir. It also serves the purpose of determining the presence and effectiveness of any water drive which might be induced by pressure drop.

The pressure-depletion procedure at 216° F. is tabulated as in Table 3.

The data in the Columns 1 and 4 are presented graphically in Fig. 9 in which the cumulative volume of retrograde condensate, in terms of barrels of liquid at 216° F. and the observed pressure per million cubic feet (theoretical) of single-phase reservoir gas is plotted as a function of pressure. This curve differs from the curve in Fig. 4 (which is superimposed for comparison) in that the temperature and volume are the constants, as would be the case in the reservoir, and the variation in pressure is the result of the removal of portions of the prevailing gas phase hydrocarbons, as would be the result

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TABLE 4—HYDROCARBON COMPOSITION OF SAMPLES TAKEN DURING THE PRESSURE DEPLETION AT 216° F. (VALUES ARE IN MOL PER CENT)

Component—	Average pressure during sampling—psi. (per cent)						
	4,393	3,785	2,980	2,462	1,817	1,058	581
CO_2	.90	.90	.90	.90	.90	.90	.90
C_1	78.02	79.08	81.00	81.54	81.94	80.83	79.80
C_2	7.43	7.13	7.17	6.95	7.13	7.25	7.37
C_3	4.88	4.46	4.35	4.35	4.51	4.57	4.89
I-C_4	1.20	1.00	.80	.98	.97	.86	1.16
N-C_4	1.65	1.62	1.51	1.45	1.38	1.64	1.53
I-C_5	.75	.72	.67	.64	.51	.61	.63
N-C_5	.60	.67	.50	.51	.46	.60	.47
C_6	1.04	1.00	.87	.72	.60	.61	.58
C_7+	3.53	3.42	2.23	1.96	1.60	2.13	2.67
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

of a production of gas from the reservoir without cycling. This procedure reflects the effect of the reservoir pressure drop on both the quantity of gas remaining in the reservoir and the change in quality, or composition, of the remaining gas phase resulting from the permanent removal of gas without reinjection of the dry gas.

The volumes of retrograde liquid, as observed, are plotted at the pressures of observation. This in contrast with the samples taken for analysis, which are plotted at the average of the pressure at the beginning and end of the sampling interval. Table 4 gives the results of the analysis of these samples.

Fig. 6 is a graphical presentation of these analyses. Each component is represented by a curve which traces the concentration of the component throughout the pressure depletion. These data are plotted on semilog paper for the purpose of emphasizing the low-percentage components, which include the gasoline hydrocarbons. This figure provides the means of ascertaining, at any intermediate pressure, the hydrocarbon composition of the cell gas phase. This is done by selecting the desired pressure on the base line, then following this line vertically to its intersection with the line representing each of the hydrocarbons in turn. Obviously the methane line cannot be read with accuracy, and must be fixed by difference. This line does, however, serve as a check against the gross misreading of the smaller percentage components.

These analyses are calculated to gallons per minute of the isobutane and heavier components as presented in Table 5.

These values are presented in graphic form in Fig. 7, as a function of pressure. In this figure, the curve showing the content of heptanes-plus is the basic curve, and is designated as "C_7+." To the values for C_7+ are then added the values for the hexane fraction and the sum of these two fractions are plotted in the same way, the resulting curve being designated as "C_6+." In turn the C_6, N-C_4 and the I-C_4 fractions are added, giving the cumulative g.p.m. content of the produced gas.

From the composition of the gas samples, as given in Table 4, are next calculated the deviation factors of the gas phase at 216° F. and the average pressures and compositions that existed at the time of sampling, using the method of George G. Brown.[4] Since all of the sample is in the vapor state at reservoir pressure, it is also possible to determine the deviation factor for this point from the P.V.T. data. This determined point serves to check the accuracy of the calculated deviation curve.

The deviation factor "Z," or the "supercompressibility" factor, which is the reciprocal of "Z," represents the departure of the gas from the behavior indicated by the application of the gas laws, and can amount to a considerable difference in reservoir engineering problems. Table 6 pre-

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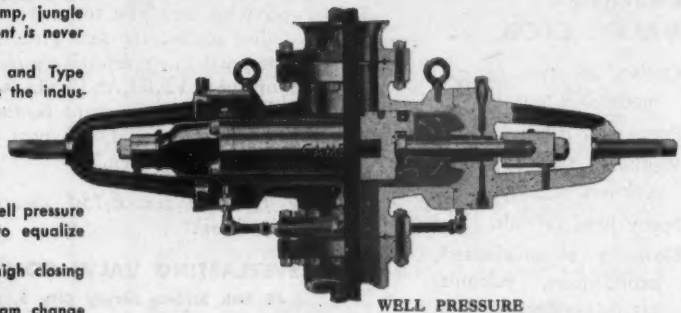

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TABLE 5—GALLONS PER MINUTE CONTENT OF GASOLINE HYDROCARBONS IN GAS PRODUCED DURING PRESSURE DEPLETION OF CELL AT 216° F.

Average pressure—	4,393	3,785	2,980	2,462	1,817	1,058	581
Isobutane	.391	.326	.261	.319	.316	.280	.378
Normal butane	.519	.509	.475	.456	.434	.516	.481
Isopentane	.274	.263	.245	.234	.186	.223	.230
Normal pentane	.217	.242	.181	.184	.166	.217	.170
Hexanes	.426	.410	.357	.295	.246	.215	.238
Heptanes+	2.126	2.060	1.343	1.181	.964	1.283	1.608
Total	3.953	3.810	2.862	2.669	2.312	2.734	3.105

sents these calculated deviation factors for the subject sample.

These data are plotted in Fig. 8 presenting the deviation factor as a function of pressure for the example. The determined and calculated values at reservoir pressure and temperature show remarkable consistency for a sample of this richness. The normal range of agreement is about ±3 per cent.

The composition of the residue of retrograde condensate at the final pressure of 462 psia. is given in Table 7. The volume of this liquid residue, as shown in Table 3, amounts to 23.47 bbl. per million cubic feet of virgin gas in the reservoir. This volume, and composition of liquid which would otherwise be lost readily suggest that, from the standpoint of the physical recovery of the liquids in place, a cycling program would be highly profitable on a reservoir of this kind provided the extent of the reserve and the structure of the reservoir are favorable.

This table completes the story of what will happen to each million cubic feet of virgin reservoir gas if it is produced by the pressure-depletion method. A material balance based on the information secured in this type of laboratory analyses is very likely to show a slight deficiency in accounting for all of the material charged to the cell. This is due primarily to the difficulty inherent in the handling of samples containing condensable components, such as the samples taken during the depletion process.

TABLE 6

Pressure, psia.	Temp. (°F.)	Deviation factor "Z"
15	60	*1.000
581	216	†.935
1,058	216	†.896
1,817	216	†.855
2,462	216	†.838
2,980	216	†.843
3,785	216	†.869
4,393	216	†.907
4,393	216	‡.911

*By definition. †Calculated. ‡Determined from P.V.T.

TABLE 7—Hydrocarbon Composition of Residual Retrograde Liquid at 462 Psia. and 216° F. Resulting from Pressure Depletion

Component—	Mol per cent	Liquid volume per cent
Methane	10.20	3.30
Ethane	2.78	1.27
Propane	3.90	2.04
Isobutane	1.30	.81
Normal butane	3.53	2.12
Isopentane	2.41	1.68
Normal pentane	2.60	1.80
Hexanes	6.86	5.38
Heptanes +	66.42	81.60
Totals	100.00	100.00

It is much simpler to produce condensation either in the sample containers or in the reservoir, than it is to revaporize these liquids. And since the only way to transfer the sample from the cell to the fractionating column is to vaporize the condensed liquid, the error is in direct proportion to the difficulty of this revaporization. The apparatus and technique play a part here.

Acknowledgment

The author wishes to thank the executive department of Gulf Oil Corp. for permission to prepare and publish this paper. Also to the Houston Laboratories, Houston, owners and operators of the apparatus described herein. He wishes also to express

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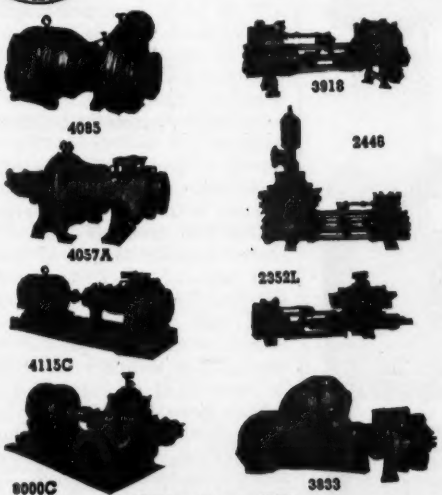

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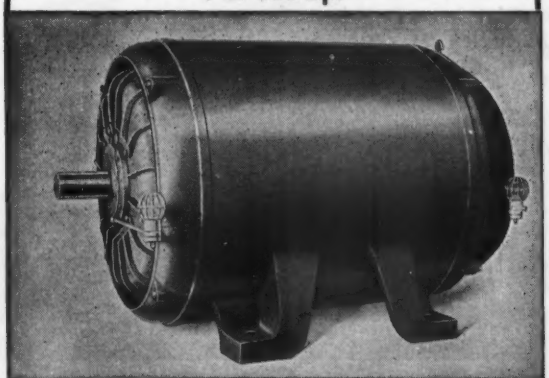

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gratitude to William H. Justice, Tide Water Associated Oil Co., Walter F. Rogers and W. H. Woods, of Gulf Oil Corp., for aid and helpful criticism in the preparation.

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3. "Valuation of Gas Condensate Reservoirs for Cycling," William H. Justice, joint meeting A.I.M.E., Austin, December 18, 1946.
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Significance of Liquids From Natural Gas

(Continued from page 111)

of storage will become increasingly important in the future as the seasonal demands for liquefied petroleum gas becomes more pronounced than at present.

Fig. 6 compares graphically for rapid survey the production of gasolines and liquefied petroleum gases for 1946 with 1947, and also compares the distribution of these materials for the same period indicating the increase in 1947 over 1946, both as to production and as to distribution. The export and unaccounted-for column is really a column used to balance the production with the known sales. Some portion of it may have been exported. However, it certainly does not mean to imply that the first seagoing propane tanker launched late in 1947, exported anything like this amount, as it is being used principally to alleviate other means of transportation within the United States.

In 1947, gasoline produced from natural gas accounted for approximately 11 per cent of the total motor fuel used in the United States. This volume is quite a large factor in our petroleum economy and will very likely become larger in the future. The demand for natural gasoline at the close of the year was increasingly firm, and the demand for liquefied petroleum gas far greater than the supply. The industry has been rapidly expanding to meet this demand, but its growth is seriously hampered and retarded due to the shortage of contruction materials. A nation-wide survey completed March 1 of this year revealed that during 1948 and 1949, the largest expansion program in the history of this industry is under way. There are 57 natural-gasoline and recycling plants either now under construction or planned and authorized in nine states during this

period. From these plants, it is estimated that 85,700 bbl. daily additional gasoline and heavier production will be recovered and 75,700 bbl. additional L.P.G.

Upon completion of these plants in 1949 natural-gasoline and L.P.G. production is estimated at 59 million barrels additional per year, which is an increase of 45.4 per cent over the industry's production for 1947. It is interesting to note that of the 59-million-barrel increased production, 47 per cent is for the recovery of additional L.P.G. and 53 per cent is for the recovery of gasoline and heavier constituents. The survey also indicated that 79 per cent of the increased production came from Texas and 12 per cent from Louisiana.

The figures from the survey indicate that approximately 60 per cent of the additional capacity will be installed in 1948 and the remainder in 1949. Completion schedules are very difficult to appraise under present conditions of material delivery, and it well may be that the larger percentage of this increase will be completed in 1949. But in any event, they show that the industry is making every effort to meet the demands of the public that it serves.

The author wishes to give due recognition to the following for data contained in this paper:

1. Petroleum Data Book, 1947.
2. U. S. Bureau of Mines and Petroleum Facts and Figures, A.P.I. 1947.
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A Study of Cycling Operations

(Continued from page 115)

Applying this average total per cent plant loss from cycling to the total residue injected the total loss due to cycling is obtained, as shown in Table 3.

From the results shown in Tables 2 and 3 the total comparative losses of B.t.u. are:

	Upper Austin	Middle Austin
Loss of residue in cycling, (billions)	2,060.0	2,113.0
Loss of liquids by depletion (billions)	1,468.0	1,241.0
Net loss by cycling (billions)	592.0	872.0

The comparison between depletion operations and cycling operations may be made on a dollars-and-cents basis. For this purpose it is assumed that the sands would be depleted to abandonment pressure in 15 years, or completely cycled in 10 years. Operating data from both upper and middle Austin sands may be combined and viewed in light of the present eco-

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nomic values. When such a comparison is made, it may be shown that some monetary gain is experienced through a cycling program in the upper and middle Austin sands in Stratton field.

TABLE 3—TOTAL DRY-GAS CYCLING LOSSES FROM PROCESSING AND COMPRESSION

Item—	Upper Austin	Middle Austin
Cum. residue injected, M.M.c.f.	43,933	45,047
Total dry gas loss, M.M.c.f.	1,981	2,032
Total B.t.u. loss (billions B.t.u.)	2,060	2,113

Conclusions

1. Although the initial study of a gas-condensate reservoir may indicate that gas cycling will result in both maximum conservation of energy and ultimate monetary return, the program should be sufficiently flexible to conclude operations at any time actual experience demonstrates that the original analysis may be in error.
2. Analysis of liquid-content tests are useful in predicting cycling efficiencies and are reasonably accurate for estimates of gas reserves in a cycled reservoir.

Acknowledgments

The authors wish to express their appreciation to the management of The Gulf Plains Corp. and The Chicago Corp. for permission to make public these data.

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BOOKS

PENNSYLVANIA PETROLEUM, 1750-1872. A DOCUMENTARY HISTORY. By Paul H. Giddens. Published by Pennsylvania Historical and Museum Commission and Drake Well Memorial Park. 420 pp.

This volume on the early history of the petroleum industry is a compilation of original documents drawn from a variety of sources—letters, newspapers, out-of-print books, oil-company records, reminiscences, etc. Many of the documents included have not been hitherto published. Other portions of the material have been published but lie buried in inaccessible newspaper files, in old books now out of print or scarce, and in scattered manuscripts. The material has to a large extent been drawn from the collection in the library of the Drake Museum.

The book is divided into five main divisions. Part 1 relates to the history of petroleum prior to 1859. Part 2 brings together all the known accounts of those who had to do with the organization of the first oil company and the drilling of the Drake well. Part 3 focuses attention on records bearing upon Drake and the Drake well. Part 4 relates to Drake after 1863. Part 5 contains contemporary accounts of the oil region 1859 to 1872.

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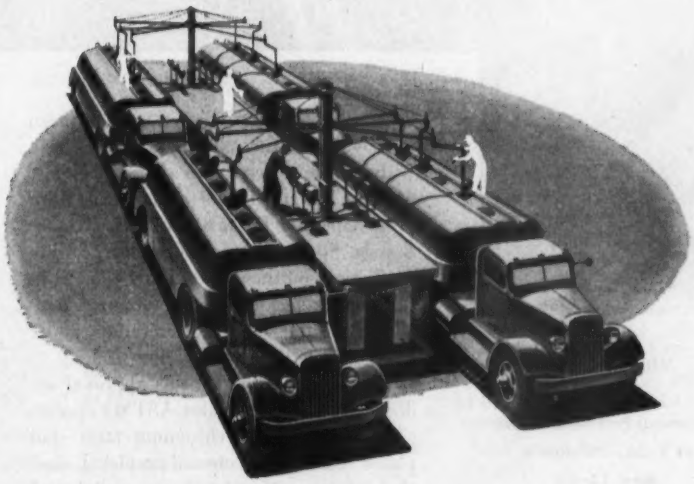

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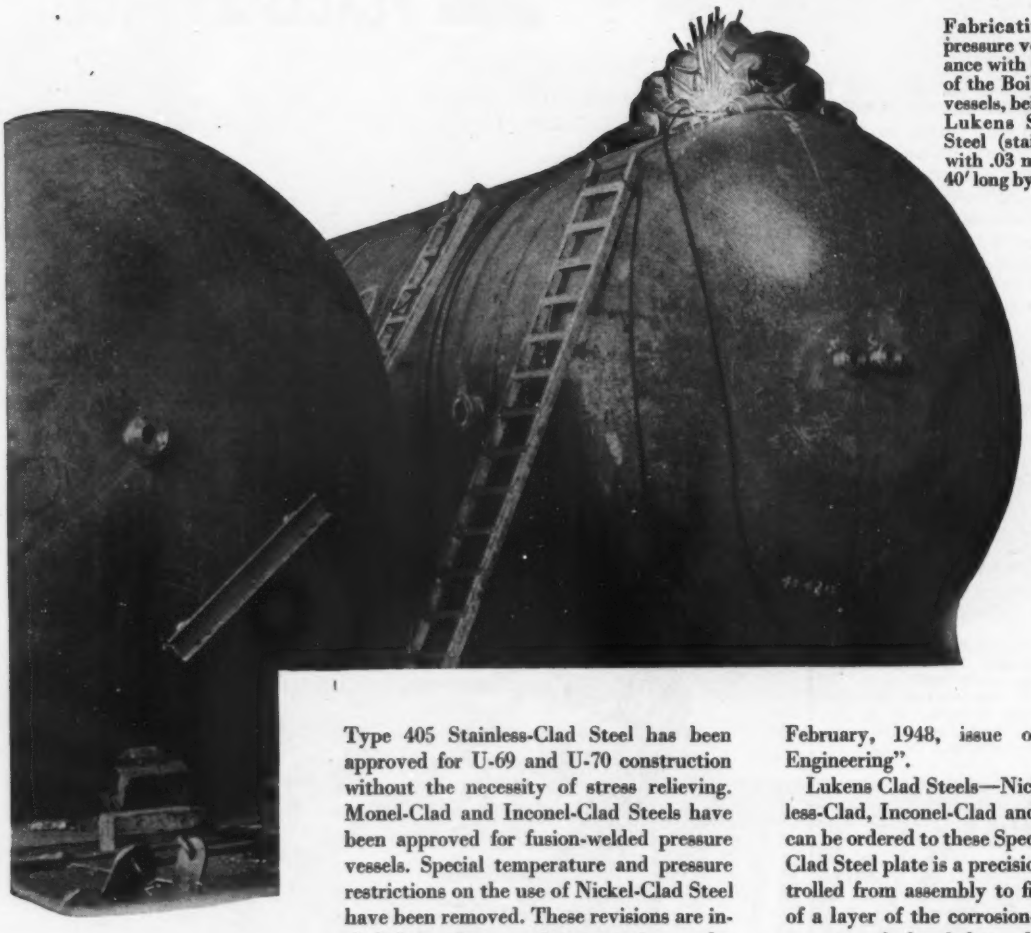

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QUESTIONS on TECHNOLOGY

by W. L. Nelson

Consulting Engineer

Loss of Gravity Crude Oil During Storage

How is the loss in gravity of crude oil related to the amount of crude oil lost?—W. E. C.

Few experimental data are available. However, the general material balance that relates loss to gravity change may be stated as:

$$A_w = \frac{100\,A_c - LA_L}{100 - L}$$

in which A_c, A_w and A_L are respectively the A.P.I. gravities of the fresh crude, weathered crude, and the material lost; and L is the percentage (by liquid volume) lost. The use of A.P.I. rather than specific gravity is satisfactory here because of the small magnitude of the losses involved, and because of the inaccuracies involved in estimating a value of the gravity of the material lost (A_L).

The composition of storage-tank gases and of the low-boiling portions of crude oils, indicates that the material lost would be largely butane and might average at about pentane. However, the crude oil does not circulate much in the tank and hence after the lightest materials (gases, butane, etc.) have evaporated from the surface of the liquid, further loss or evaporation consists of higher-boiling materials. Of course, the behavior of a crude oil will be a function of its particular composition. Information on Seminole crude and on a mixture of it with 3 per cent of 26-lb. natural gasoline (Huntington, Elements of Vaporization and Condensation, Part 8, Ref. Nat. Gaso. Mfr., April 1941, page 85), showed that the gravity of the material lost during 9 days of weathering ranged from 74.4° to 81.8° A.P.I. Thus, the material lost was not primarily gases but was a light gasoline-like material averaging around heptane or octane.

Losses range from 1.5 to 4.0 per cent for a decrease of 1° A.P.I. gravity (*"Loss in Gravity During Storage," The Oil and Gas Journal, August 18, 1945, page 143*). This indicates that the gravity of the material lost ranges from about 60° for almost gas-free crudes to about 100° for fresh crude oils.

Composition of Catalytic Gasoline

We hear it stated that catalytic gasolines are rich in aromatic hydrocarbons. How much do they contain and could they be used as a source of aromatics for chemical manufacture?—N. M. C.

The composition of catalytically cracked gasolines varies widely with the operating conditions, and to a minor extent with the type of charge stock. The aromatic content is increased to some extent by operating at higher temperatures but the production of olefins also increases. Table 1 indicates the general analyses of several catalytic gasolines. Items 1, 2, and 6-11 indicate the effect of boiling range or the aromatic content of various boiling ranges. Little aromatic material is present in the benzene boiling range (up to 200° F.) but the boiling range of 250°-300° F. may consist mainly of aromatics at least for fluid process gasolines. In general, naphthenic charge stocks (Items 3, 5, and 9-11) produce gasolines that are richer in olefins and slightly richer in aromatics and naphthenes. Cracked and straightrun gasolines are indicated in Items 12 and 13 for comparison. Thus, catalytic gasolines contain somewhat larger amounts of aromatic than thermally cracked gasolines but the difference is not great. Finally, select crude oils such as those of the Conroe, Texas; Mexia, Texas; and Maljamar, New Mexico, fields are rich in aromatics. Straightrun gasolines from these crude oils contain 14-27 per cent aromatics *(see Aromatic base crude oils, The Oil and Gas Journal, October 28, 1944, page 101)*.

TABLE 1—CHEMICAL ANALYSES OF CATALYTIC GASOLINES
(Per cent)

	Unsaturated	Aromatic	Naphthenic	Paraffinic
1. Houdry from Mid-Continent and Gulf Coast gas oil, 437° F. end point	8.0	24.0	21.0	47.0
2. Houdry from Mid-Continent and Gulf Coast gas oil, 437° F. end point	9.0	16.0	19.0	56.0
3. Houdry from Coastal crude, 437° F. end point	24.0	18.0	24.0	34.0
4. Houdry aviation from paraffinic stock	4.0	9.0	7.0	80.0
5. Houdry aviation from naphthenic stock	3.0	13.0	25.0	59.0
6. Fluid, paraffinic stock, 115°-200° F.	24-44	1-8	15-29	63-83
7. Fluid, paraffinic stock, 200°-250° F.	11-40	13-59	18-35	18-52
8. Fluid, paraffinic stock, 250°-300° F.	2-21	36-87	1-35	9-29
9. Fluid, naphthenic stock, 115°-200° F.	6-58	1-6	29-40	56-70
10. Fluid, naphthenic stock, 200°-250° F.	8-73	14-60	25-52	15-41
11. Fluid, naphthenic stock, 250°-300° F.	2-65	34-93	1-40	6-26
12. Average thermally cracked	16	17	15	52
13. Average straightrun	3	9	21	67

Molecular Weights of Lubricating Oils

Where can we locate the molecular weights of lubricating oils in terms of viscosity, gravity, etc?—C. B. S.

The general relationship between molecular weight, viscosity and other properties is available from many sources but unfortunately, different results are obtained from each source. Perhaps the most widely used relationship is the series of properties (including molecular weight and viscosity) related to characterization factor developed by Watson, Nelson, and Murphy *(reproduced in The Modern Cracking Process, The Oil and Gas Journal, July 2, 1936, page 34;* or in Petroleum Refinery Engineering, McGraw-Hill Book Co., Inc., New York, 1941, as Figs. 35 and 36). A more recent and probably more satisfactory relationship was presented by Mill et al in their "Molecular Weight-Physical Property Correlation for Petroleum Fractions," (Ind. Eng. Chem., Vol. 38, p. 442, 1946), and Table 1 presented here was read from a figure in their paper.

TABLE 1—APPROXIMATE MOLECULAR WEIGHTS AS A FUNCTION OF GRAVITY AND VISCOSITY

Gr. 60/60 Spec.	Gr. 60/60 A.P.I.	Universal Saybolt viscosity at 210° F. 40	50	60	70	80	90	100	120	140	160	180	200	250	300
0.83	39.0	390	520	610	680	...	...	...	...	...	...	...	...	...	...
0.85	35.0	370	485	565	620	665	...	...	...	...	...	...	...	...	...
0.87	31.1	350	455	525	575	615	650	680	...	...	...	...	...	...	...
0.89	27.5	335	425	480	530	565	595	620	660	...	...	...	...	...	...
0.91	24.0	320	395	440	480	515	540	565	605	635	655	680	...	...	...
0.93	20.6	300	366	408	440	465	490	510	545	572	595	613	635	673	...
0.95	17.4	286	345	380	405	427	445	460	485	515	532	550	565	600	630
0.97	14.4	276	322	350	372	388	404	415	440	465	480	495	510	540	565
0.99	11.4	268	305	328	345	357	370	380	400	416	432	446	458	483	508
1.03	5.9	252	280	295	308	315	325	330	340	352	360	367	375	390	406
1.07	0.7	235	260	275	285	290	297	300	308	315	320	326	330	340	347

Gas Conservation, High Recovery

(Continued from page 124)

gal. of 14-lb. R.v.p. natural gasoline, and 8,300 gal. of L.P.G. per day. Of the total gas throughput, 90 per cent is charged to pipe line, 4.5 per cent is used as plant fuel, 1 per cent is returned to leases, and shrinkage accounts for 4.5 per cent. Lean-oil rates average, in gallons per minute, 55.3 over each high-pressure absorber, 200 over the low-pressure absorber, and 26.7 over the propanizer reabsorber. Lean oil rates can and will be increased to recover even greater volumes of L.P.G. A third fractionator to be constructed at an early date, will permit production of commercial propane as an additional product.

The plant was designed and constructed by Hudson Engineering Co. of Houston. Manufacturers of the principal equipment in the plant include:

Pressure vessels, Wyatt Metal & Boiler Works and A. O. Smith Corp.; heat-exchange equipment, American Locomotive Co., Alco Products Division; generators, Electric Machinery Corp.; generator drivers, Ingersoll-Rand Co.

Compressors, Cooper-Bessemer Corp.; pumps, Worthington Pump & Machinery Corp. and Ingersoll-Rand Co.; boilers, Babcock & Wilcox; cooling tower, Hudson Engineering Corp.; instruments, Taylor Instrument Cos.; control valves, Fisher Governor Co.; buildings, Braden Steel Corp.; motors, The Louis Allis Co.

L. P. G. Recovery

(Continued from page 118)

richness of the inlet gas, and other factors, the order of 150 psig. in the first still and 50 psig. in the second illustrates a typical case.

In rich-oil desorption the cold rich oil from the absorber is contacted countercurrently in a bubble-plate tower with gases rich in propane-butanes, as may be available from the plant vent vapors. Where single-stage stills are used, the uncondensed vapors from the still overhead coolers or make tank are usually suitable. The propane and heavier in these vapors are absorbed by the rich oil while some of the ethane and lighter content of the oil is stripped out or displaced. This method is an excellent adjunct to the flash-flood system as it is one of the few methods for reduction of light ends in the cold oil. As this method, once installed, adds practically no operating expense to the plant, it is a valuable process for the process designer to keep in mind. The rich-oil deethanization and the two-stage stripping methods may be more effective in eliminating the light ends but likewise increase operating expense appreciably.

Lean-oil presaturation is a process introduced several years ago for a rather specialized application. The process consists in passing the lean oil before it goes to the absorbers over a preabsorber where it contacts vent vapors from the plant at the highest pressure possible without recompression. In so doing, the lean oil absorbs a high quantity of the vent vapors and increases in temperature due to heat of absorption.[4] It then passes through lean-oil coolers to the top of the main absorbers.

The volume of vent gases that were absorbed in the presaturated oil reduces the volume of light ends that would have been absorbed from the inlet gas and thereby these constituents are, in effect, transferred from the vent vapors to the plant residue. This is accomplished by liquid pumping instead of vapor compression. The removal of much of the heat of absorption by presaturation is equivalent to using an intercooler, thereby reducing effective absorption temperature and increasing the propane absorption.

This process is particularly applicable where the main absorber operates at a high pressure to deliver residue gas and where the extraction in the

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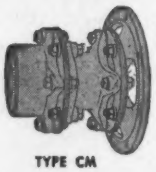

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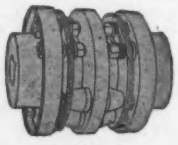

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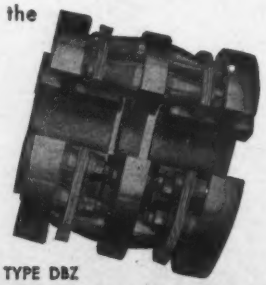

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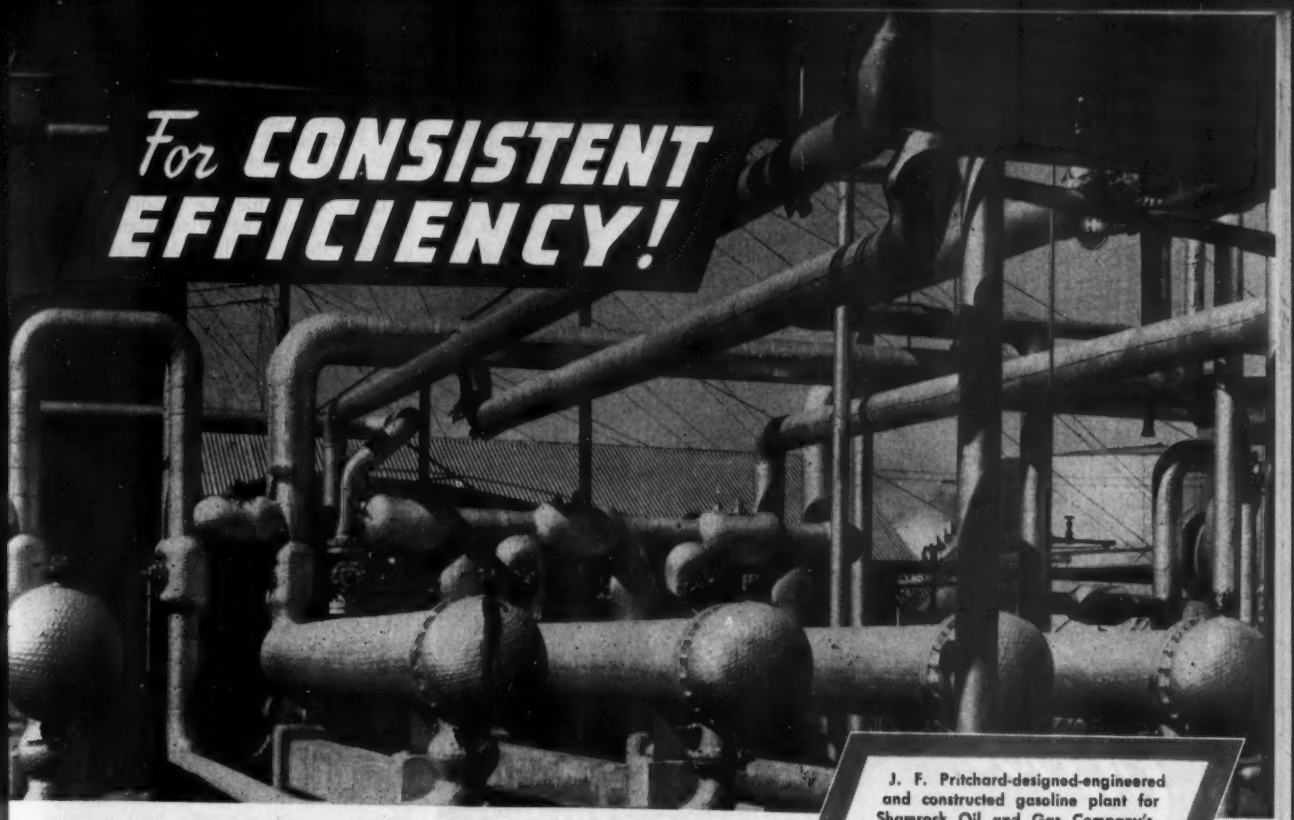

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main absorber is limited by B.t.u. requirements on the residue gas. In effect, the residue gas is enriched by the heavier constituents in the plant low-pressure vent vapors.

Selection of Process Flow

There are many factors and variables that must be considered in choosing the process flow for a new extraction plant or revision of an old one, usually requiring that the process designer calculate several alternate cases for selection of the one most desirable. This will usually be the most economical case, but in some instances such factors as flexibility for possible future needs may wield a strong influence.

Major factors that mold the process flow are listed below, omitting the strictly economic factors such as prices received and paid. The economic factors, although affecting the payout and the economic depth of extraction, do not affect the choice of one flow system over another for the same product recovery.

1. Inlet gas volume, pressure, and composition.
2. Residue gas requirements as to volumes, B.t.u. limitations, temperature, and pressure.
3. Product outlets.
4. Existing equipment (when the project is a plant extension or revamp).
5. Equipment availability.
6. Flow schedule or load factor.
7. Flexibility as to present or possible future operating needs.

A study of the first two items will usually determine the absorber pressure and depth of extraction for the process design. Then several alternate flow schemes may require calculations and economic analysis before selection. If there are no restrictions other than economics on the depth of extraction, it may be necessary to include cases for several depths of extraction and recovery. A careful study of the factors and flow possibilities may narrow the selection by critical elimination. Likewise, judicious choice of operating conditions will lighten the burden of cases that require calculation. Items 4 and 5 should be kept constantly in mind, for they are unpredictable and may upset the labors of many painstaking calculations.

As an illustration of process choice, assume a case with these premises: (1) An inlet gas volume of 140,000,000 standard cubic feet per day of moderately rich gas with ample reserves for a long plant life; (2) low-pressure field trap conditions such that the gas enters the plant at atmospheric pressure and requires compressors; (3) no residue gas limitations as to pressure or extraction depth; (4) products to be sold as grade natural gasoline and L.P.G. This example illustrates a case where the cost of compressing the inlet gas to the absorption pressure must be borne by the gasoline and L.P.G. products recovered without aid from increased value of the residue gas due to pressure. An appropriate flow system is presented in Fig. 3.

Some of the economics showing the advantages of the flash-flood system, as given in Fig. 3, are compiled in Table 1. For the purposes of this comparison the investments and operating costs for equipment to compress the gas to the 250 psig. level are not included since these costs are common to all the cases presented. The tabulated figures show that the flash-flood system at 250 psig. absorption pressure accomplishes 80 per cent propane extraction at an investment saving over straight absorption at the same pressure, with but $37,000 greater annual operating expense which would require the average lifetime to pay out the difference in investment. The same extraction may be accomplished at 600 psig. by straight absorption at 6 per cent higher investment and 18 per cent higher operating expense than for the flash-flood system at 250 psig.

Suppose, though, that the inlet gas were available at a high pressure, such as 1,000 psig., and that a residue gas contract limited extraction to 50 per cent of the propane and all of the butanes-plus. The lean-oil requirement for this extraction would be lowered to the extent that flash-flood would not be advantageous. A

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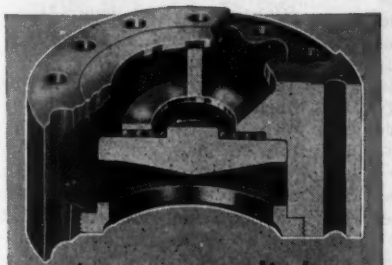

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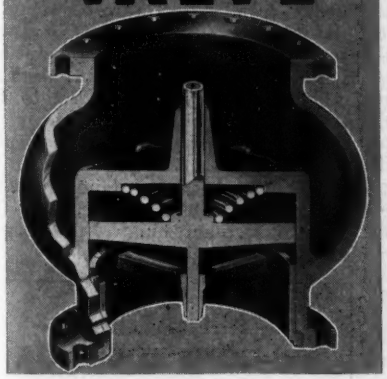

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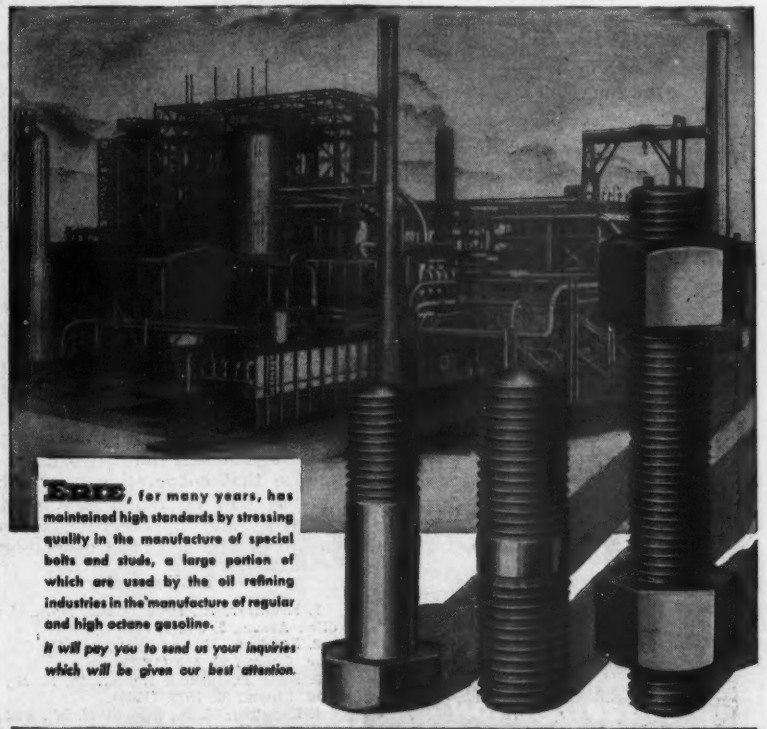

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flow scheme that would be indicated is shown in Fig. 4.

The many factors affecting the selection of the most economical plant flow and then selection of optimum operating variables present a complex task to the modern process designer. General rules, formulated for process selection by defined limitations of such factors as inlet gas richness and pressure, become clouded and unsafe by the combination of the many local factors that must be considered for each individual case.

As a closing thought it is predicted that the present trend toward deep extraction of propane and eventually ethane will alter future plant processes from the absorption-oil types to low temperature liquefaction.[13] The original purpose of the natural gasoline plant was to remove the "wet" or heavy gasoline ends but the present-day trend is to make the separation not at the bottom but at the top, removing the light gases from the liquefiable hydrocarbons. This objective, it seems, should be accomplished more efficiently by straight low-temperature fractionation of the inlet gas. The high energy requirements for pumping, heating, stripping, and cooling of the absorption oil indicate promise for low-temperature liquefaction separation methods, which are thermodynamically more direct. The introduction of any foreign medium, such as absorption oil or charcoal, increases the energy requirement for separation.

In some areas where extraction is limited by B.t.u. limitations on the residue and where there is appreciable nitrogen in the gas, low-temperature liquefaction offers the advantage of nitrogen separation. Removal of nitrogen would allow deeper extraction of propane and ethane, if desired, and would save the pipe-line cost of transmitting the inert nitrogen. Not only could horsepower be saved for transmitting the inert material, but existing pipe-line and compressor installations could be made to handle more therms.

Although the process of low-temperature liquefaction has not been completely developed, representatives of both the natural-gasoline and gas-transmission industries must recognize that cooperative approach to its use will be required if denitrogenation and hydrocarbon recovery are to be attained most economically.

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More Propane

(Continued from page 127)

ment of Fluor Corp., and who is now with Fish Engineering Corp.

At the time the Lake Creek plant was built, the demand for propane was such that it was not considered desirable to make any special provision for its recovery. Soon after the plant was put into operation there was an increased demand for propane; so, with the equipment at hand, an experimental program was begun to increase propane recovery.

The plant was originally designed to operate at 1,500 psi. absorber pressure, with an absorption oil having a mean molecular weight of approximately 230. To obtain more propane, the refrigeration unit was put into operation and some improvement in over-all recovery was experienced, but not any more than would be expected from temperature reduction of the absorption medium. It was observed that when the temperatures were dropped, the loss of absorber oil was decreased. This led to the thought that with a lower temperature in the absorber, the molecular weight of the absorption oil might be reduced. With this in mind, the temperature was further reduced and the mean molecular weight of the oil was likewise lowered.

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Equipment was installed to dehydrate the gas ahead of the main absorbers and the low-pressure still was converted from steam stripping to stripping with direct heat. It was then possible to operate with a lean-oil temperature of 60° F. using an oil having a mean molecular weight of 155. With this temperature and molecular weight, the oil losses in the plant were substantially the same as when using 230 mean molecular weight oil at a temperature of 90° F.

Since the plant was operating at a pressure of 1,500 psi., the reduced temperature did not add appreciably to the propane recovery, but it did allow the mol weight of the absorption oil to be lowered from 230 to 155, thereby increasing the molecular circulation by approximately 45 per cent. The combination of reduced temperature and lowered molecular weight effected a much greater overall recovery of propane, and substantially 100 per cent of all butanes and heavier constituents.

New Plant in Louisiana

A new plant, incorporating, in general, the basic features of this experimental work, has been designed by Fish Engineering Corp. for Southwest Gas Producing Co., Inc., and W. C. Feazel.

The plant, which is being constructed near Dubach, La., will have a capacity to process 90,000,000 cu. ft. of gas per day and recover 80 per cent of the propane. It will operate at 900 to 1,000 psi. Wells supplying gas to the plant will have a flowing pressure of 2,500 to 3,000 psi. and the gathering-system pressure should be in the neighborhood of 1,500 psi. It is estimated that after reduction to the plant operating pressure, the inlet gas will have a temperature not in excess of 90° F. The gas will enter an inlet surge tank equipped with a long-range level control to smooth out surges of flow through the plant. It will then be dehydrated by use of Florite contactors.

Liquid leaving the inlet surge tank will be passed through a filter to remove entrained water. The dehydrated gas and "dry" liquid will then be commingled and cooled to approximately 60° F. by propane refrigeration. The distillate will be separated and passed to a distillate fractionating system, while the gas enters the main absorbers.

The absorption oil desired will be a light kerosine cut having a mean mol weight of 155 and a gravity of about 49° A.P.I. Chilling the absorption oil to 60° F. is expected to reduce retrograde vaporization to a minimum. Lower temperatures in the absorber will also afford a certain amount of selective absorption. Smaller quantities of methane and ethane will be absorbed in proportion to the amount of propane. An examination of vaporization equilibrium constant curves reveals that the drop in temperature has much more effect on the "K" value of propane than on that of methane and ethane. This is no trivial factor since getting rid of fixed gases is an expensive and troublesome problem in high propane extraction.

Dehydrating the gas before it enters the absorbers should aid in preventing corrosion throughout the plant. This is particularly important since gas in this field has a high carbon dioxide content.

The distillate fractionating system will yield naphtha overhead, kerosine as a side cut, and gas-oil as a bottom product. The distillation unit handling rich oil from the absorbers will yield propane, mixed butanes, and natural gasoline having a Reid vapor pressure of 12 to 30 in. By making the two products, natural gasoline and naphtha, full advantage of all market conditions can be realized. Should octane requirements necessitate the production of finished products having a wide differential between the research and A.S.T.M. number, the naphtha can be reformed and blended with natural gasoline to produce the desired specification of motor

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Rich oil from the absorption system enters a high-pressure still operating at 155 psig. A preheater ahead of this still raises the oil to a temperature of 390° F. Only sufficient live steam is introduced into the high-pressure still to strip the oil of gasoline having an end point of approximately 225° F. The partially stripped oil then enters a low-pressure still operating at nearly atmospheric pressure. Because of the use of light absorption oil and partial stripping in the high-pressure still, the oil can be completely stripped at this point without the use of live-steam agitation. This is accomplished by using a reboiler on the base of the low-pressure still which raises the temperature to about 410° F. The only live steam which comes in contact with the lean absorption oil is that used for agitation in the high-pressure still, and it will be distilled off before the lean oil reaches the absorbers.

The plant is unique in that it will have no direct-fired heaters on the rich-oil stream. The design of most plants requires direct-fired heaters, and quite often the oil is heated to a temperature higher than necessary. In some cases, hot oil enters the still at a temperature 30° or 40° above the bottom temperature. This means that an excess amount of reflux is being used to cool the tower thereby increasing the cooling tower load. Certainly the elimination of direct-fired heaters is desirable from the standpoint of safety.

Basic features and advantages of the new type plant design are summarized as follows:

1. The wet gas will be dehydrated before it enters the absorbers, thereby allowing both the gas and absorption oil to be cooled by refrigeration far below the temperatures at which hydrates would ordinarily form.

2. This low temperature permits the use of a very light, low-molecular-weight absorption oil without serious loss due to retrograde evaporation.

3. The use of a low-molecular-weight oil, in turn, increases the propane extraction while at the same time it keeps the lean oil circulation to a minimum. When using the low-molecular-weight oil, only slightly more than one-half as much oil circulation is required.

4. Operating at lowered temperature permits selective absorption thus eliminating much of the troublesome fixed gases which are normally picked up.

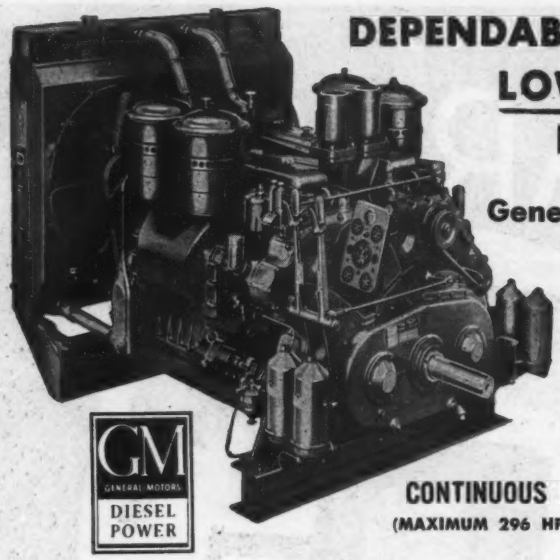
5. Minimum oil circulation and partial elimination of fixed gases results in considerable savings because of decreased heating loads, sizes of vessels, pumps and other equipment. Over-all savings in cost of installation will vary, of course, with capacity, richness of the gas, and other conditions. For our particular plant, the saving over conventional design is estimated to be about 15 per cent. In our opinion, savings considerably in excess of this amount can be made on future plants.

6. "Dry" distillation leaves the residue gas free of moisture and suitable for pipe-line transmission. This permits dehydration to be done at the inlet of the plant.

7. Elimination of moisture from the absorber and residue gas system will tend to prevent corrosion in plant equipment.

8. There are no direct-fired heaters in the plant. All heating is done with steam although the heavier products have a boiling range in excess of those recovered in many high-pressure gasoline plants.

It is understood that patent application has been made covering the combination: dehydration ahead of the main absorbers, refrigeration of the oil and gas to the main absorbers, and the use of a low-molecular-weight oil in conjunction with dry distillation or some other method which might produce a dehydrated lean oil for absorption purposes. The patent rights have been assigned to Fish Engineering Corp.



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ENGINEERING *fundamentals*

Capillary Forces—Wettability

THE concept of surface tension was discussed in Engineering Fundamentals No. 325. This quantity alone is insufficient completely to define capillary forces because the surface or interfacial tension characterizes only the contact between two fluids. The knowledge desired is the manner in which the two fluids behave when in contact with a solid surface. The extra variable necessary to describe this behavior is the contact angle that the fluids make at the solid surface. This term is an evidence of a general property termed wettability.

In Fig. 1 are shown two opposite cases of capillary action or wettability. The rise of water in a capillary tube (Fig. 1) was discussed previously, and it was stated that the relationship between the variables would be:

$$\gamma = -\frac{rh\rho g}{2\cos\theta} \qquad (1)$$

In this particular case, it is said that the water wets the glass capillary. In Fig. 1B, the opposite effect is shown. Here is considered the depression of mercury in a glass capillary. Equation 1 relating the variables is still a valid equation for this situation although it is apparent that h will have a negative value. In this case, it is said that the mercury does not wet the glass capillary.

Whether a given liquid will rise or fall in a capillary can be described analytically in Equation 1 by the contact angle, θ. This angle is defined as that measured through the liquid between the plane of the solid surface and the plane of the liquid surface at the point of contact. Thus, for water rising in the capillary, the value of θ is less than 90° and the mercury depressing in the capillary, the value is greater than 90°. Since the cosines of angles between 90° and 180° are negative, h must be negative in Equation 1 when it is applied to Fig. 1B. For a value of θ exactly 90°, the liquid would neither rise nor fall. The point should be stressed, therefore, that surface tension and the characteristic called wettability express different properties of a capillary system. A high surface tension alone will not permit a fluid to rise to a great height in a capillary. The property which determines whether the fluid will rise or fall is that property which gives the contact angle. The contact angle which a given system enjoys will be determined by the nature of the two fluids and the solid surface of the system.

The generality of these considerations is not lost by applying them to the behavior of two liquids within a capillary. Figs. 2A and 2B show the counterparts of Figs. 1A and 1B when oil and water are considered within a capillary. If the situation of Fig. 2A occurs, water is said to wet preferentially the solid surface. If the situation of Fig. 2B occurs, oil is said to wet preferentially the solid surface. In either case, the wettability can be defined by the contact angle, that is, by the fact that its value is less than or greater than 90°.

Equation 1 will not express the relationship of variables in Fig. 2 because the density of the oil is not negligible. The equation becomes:

$$\gamma_{o\text{-}w} = \frac{rh\,(\rho_w - \rho_o)\,g}{2\cos\theta} \qquad (2)$$

Nomenclature:

- r = radius of capillary tube, cm.
- θ = contact angle
- h = height of capillary rise, cm.
- γ = surface tension, dynes/cm.
- $\gamma_{o\text{-}w}$ = interfacial tension between oil and water, dynes/cm.
- ρ = density, g./cm.^{3}
- g = acceleration due to gravity

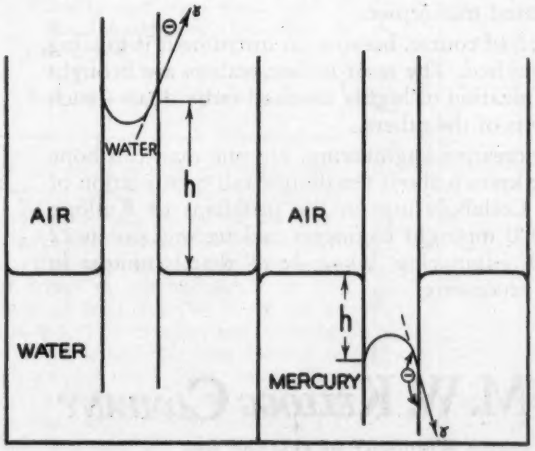

Fig. 1A

Fig. 1B

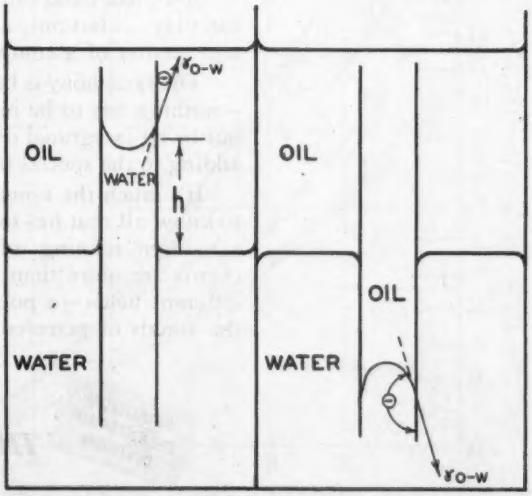

Fig. 2A

Fig. 2B

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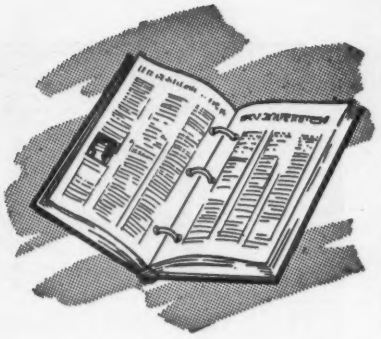
The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL



Friction Loss-Condenser Tubes

TENTATIVE SCHEDULE

Currently topics are related to friction losses, fluid flow, and hydraulics:

No. 187—Mar. 11—Coil-in-Box Condensers.

No. 188—Mar. 18—Threaded Joints.

No. 189—Mar. 25—Condenser Tubes.

No. 190—Apr. 1—Pipe Coils.

No. 191—Apr. 8—Pressure-Temperature Ratings.

No. 192—Apr. 15—Retiring Thicknesses.

No. 193—Apr. 22—Sampling Methods.

No. 194—Apr. 29—Friction Factors.

FRICTION LOSSES IN EXCHANGERS AND CONDENSERS

No. 83—Mar. 2, 1946—Routing of Fluids.

No. 89—Apr. 20, 1946—Velocity in Shells of Exchangers.

No. 97—June 15, 1946—Pressure Drop Through Tube Side.

No. 98—June 22, 1946—Pressure Drop Through Tube Bundle.

No. 99—June 29, 1946—Fin-Tube Exchangers.

No. 163—Sept. 27, 1947—Velocity and Pipe Size.

No. 186—Mar. 4, 1948—Vapor Lines.

No. 187—Mar. 11, 1948—Coil-in-Box Condensers.

THE friction loss of water flowing inside of tubes in tubular condensers can be estimated from Fig. 1. The loss caused by the contraction into and enlargement out of boxes or compartments at the ends of tube bundles is shown at the top. The friction loss through a 10-ft. length of tube bundle is shown for tube sizes of ⅝-1-in. o.d., and the minor effect of gage or tube thickness is indicated by dotted lines.

Friction losses in terms of head of water are shown on the right side of the figure. It is based on a water temperature of 60° F. For other water temperatures the head in feet of water may be multiplied by these almost negligible factors:

60° F.	1.00
100° F.	1.006
140° F.	1.016

Example.—A two-pass tubular condenser has a 14-ft. tube bundle. The outside diameter of the tubes is ¾-in., and the velocity of flow is 7 ft. per second.

According to Fig. 1, the entrance and exit friction loss is 1.25 psi. The loss per 10-ft. length is about 1.8 psi.

Boxes	1.25
Tubes $\frac{2 \times 14}{10} \times 1.8$	5.03
Total friction, psi.	6.28

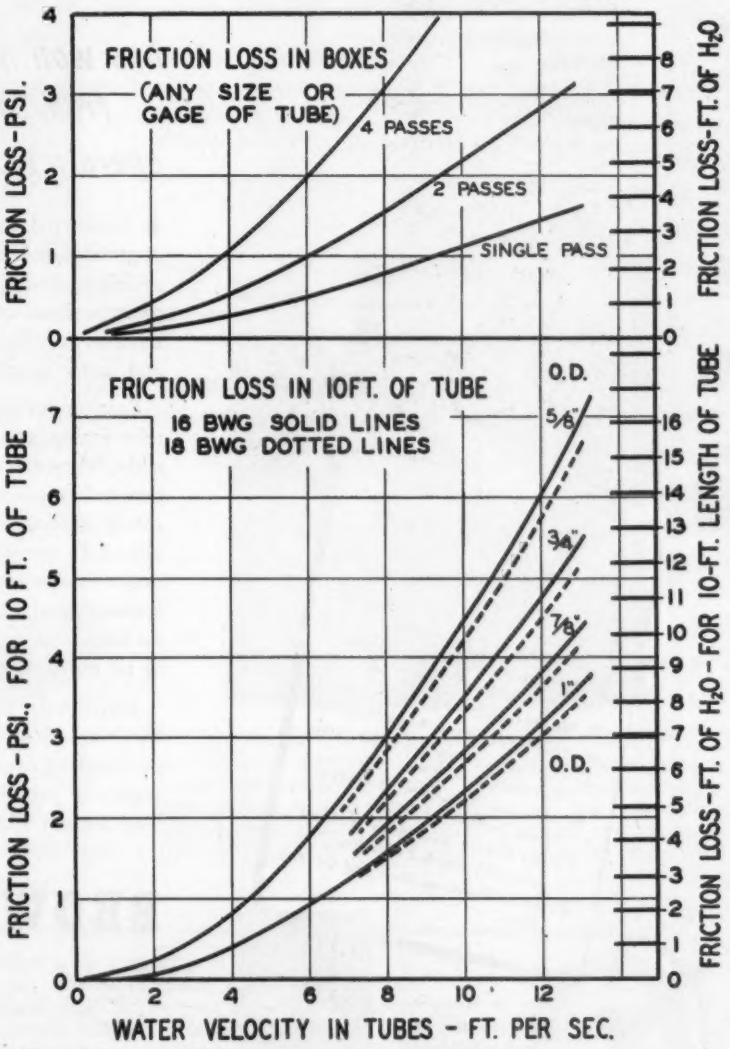
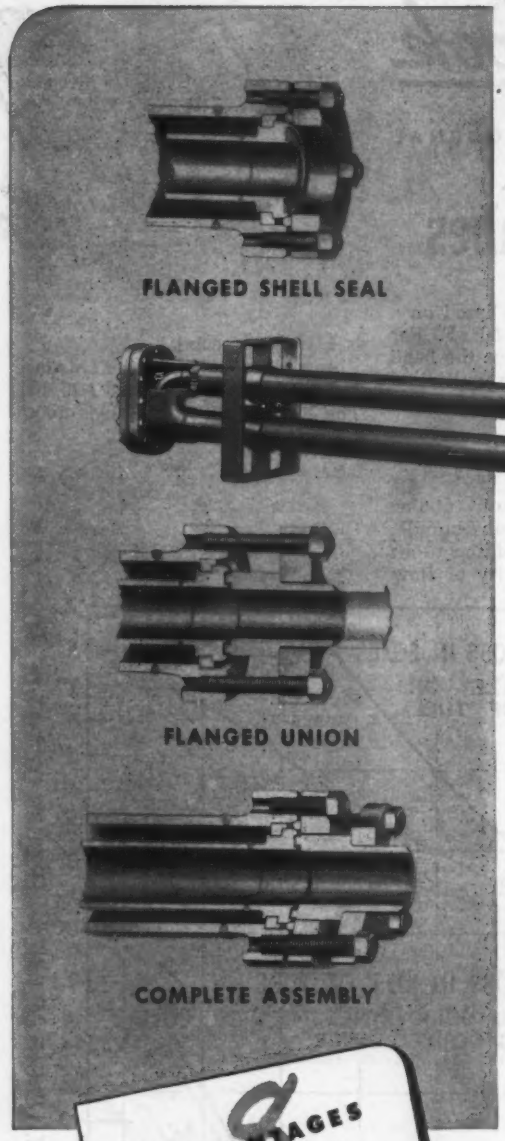


Fig. 1—Approximate friction loss of water-cooled tubular condensers

No. 189 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa



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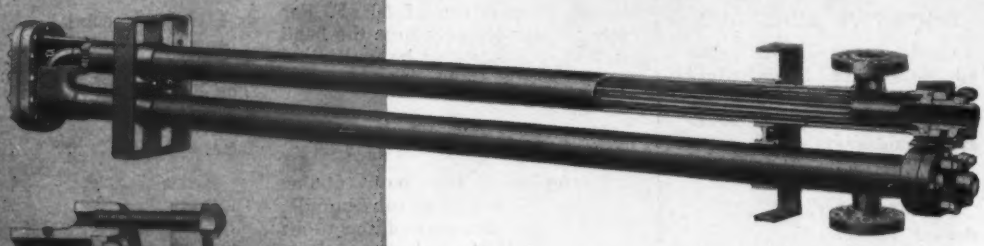

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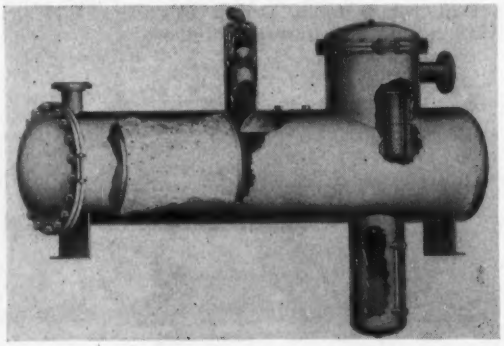
OIL AND GAS EQUIPMENT Digest

IT'S NEW CHECK IT

by John M. Spears

(1) NEW SEPARATOR FILTER is a combination unit which operates in three stages. First stage removes pipe scale and other large bodies of foreign matter. Second stage removes particles 25 microns or larger while the third stage removes particles 10 microns or smaller.



Other features of unit consist of a water-accumulator chamber, an air-eliminator mechanism, and builtin steam or electrical immersion heaters. Consolidation of several primary operations into one package permits a saving in piping, space, fittings, extra vessels, labor, leaky connections, duplicate concrete footings, etc. Excel-Co "FE" separator filters incorporate any or all of the features named in any capacity from 10 to 1,500 g.p.m. and in any code construction up to 1,000-lb. working pressure. *Warner Lewis Co.*

IT'S NEW CHECK IT

(2) RUB-R-LITE, a new type flashlight approved by Underwriters' Laboratories, Inc., for use in hazardous locations, class 1, group D has all working parts (including bulb-ejector mechanism) contained in a small sealed-in-head unit, which is "popped" in or out of the steel-lined neoprene case whenever bulb or batteries are to be changed. Light works on a new principle utilizing a single button switch. Parts are easily replaceable; there are no outside sliding parts. The prefocused "head unit" fits into the neoprene case forming an airtight, waterproof and vaporproof fit. Case is designed to take abuse. Dropping or throwing the flashlight will not damage it. Submerging it in oil or water cannot hurt it. *Lennan Lights, Inc.*

IT'S NEW CHECK IT

(3) HYDRAULIC PORTABLE FLOOR CRANE for the oil industry is for heavy lifting and moving of equipment. Crane is particularly suitable for repairing servicing

hoists, portable drilling rigs, and truck equipment. Crane, by means of hydraulic pump and power cylinder, actuates the cantilever arm and lifting hook. Lifting is done with back-and-forth strokes of the convenient waist-high operating lever. Lifting range extends from floor level up to 10 ft. 5 in.; and the extension boom adds

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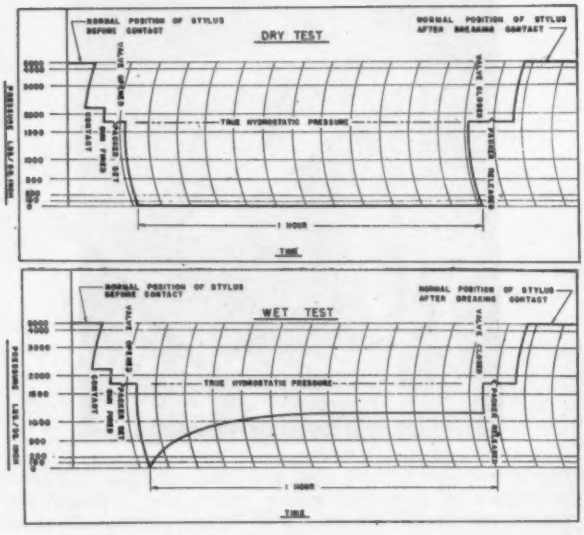
another 42 in. to the total lift. To lower the load, a release valve located alongside the operating handle is opened. Lowering is always smooth and under positive control with load of any weight. The over-all width is less than 35 in., permitting the crane to work in narrow aisles and through ordinary doorways. *U. S. Equipment Co.*

IT'S NEW CHECK IT

(4) SURFACE RECORDING PRESSURE BOMB saves testing time during water shutoff and perforating operations. Instead of having the pressure recorder installed below the packer down in the casing, the recorder is aboveground, where all pressure variations which occur during the test are instantly registered on a chart. Surface recorder enables the operator to get the next operation under way immediately, while the tester is being withdrawn from the well. The testing tool, including pressure-sensitive element and gun perforator, is run into well on operator's drill pipe or tubing to a point at which the holes are to be shot. Then a sinker bar and electrical contactor are run into well on the regular perforating wire line. When sinker bar sets down on a companion connection in the testing tool, continuity is established between electric-firing assembly in gun perforator, the pressure-sensitive element, and electric-operating and control instruments at the surface. Recorder instantly shows that gun has been fired, and starts to draw a curve of the pressure to which the pressure-sensitive element is exposed. *McCullough Tool Co.*



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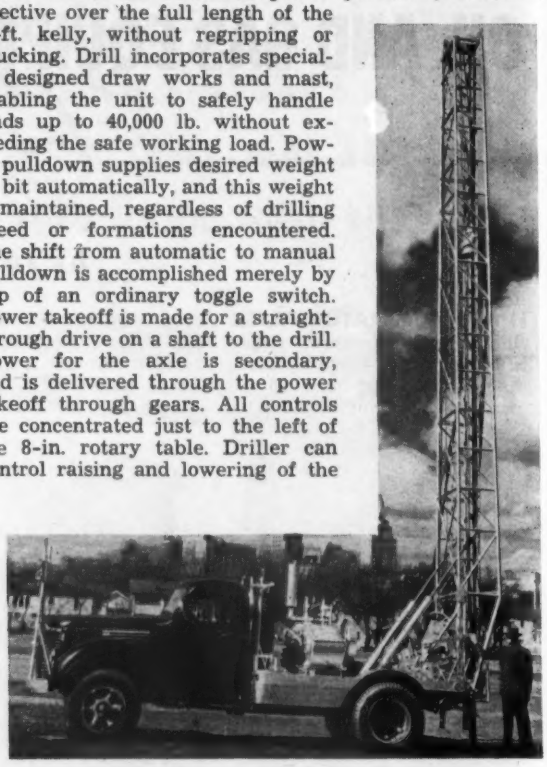
(5) NEW ROTARY DRILL is truck mounted for water-well drilling and medium-depth exploratory work. It includes use of an automatic power pulldown, which is effective over the full length of the 25-ft. kelly, without regripping or chucking. Drill incorporates specially designed draw works and mast, enabling the unit to safely handle loads up to 40,000 lb. without exceeding the safe working load. Power pulldown supplies desired weight on bit automatically, and this weight is maintained, regardless of drilling speed or formations encountered. The shift from automatic to manual pulldown is accomplished merely by flip of an ordinary toggle switch. Power takeoff is made for a straight-through drive on a shaft to the drill. Power for the axle is secondary, and is delivered through the power takeoff through gears. All controls are concentrated just to the left of the 8-in. rotary table. Driller can control raising and lowering of the mast, operation of the Wheatley mud pump, the draw works, cathead, engine speed, power pulldown and its weight adjustment, as well as the operation of the drill, from his one station. *Engineering Laboratories, Inc.*



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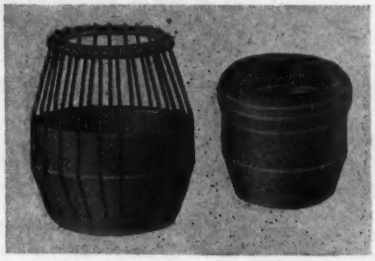
(6) LIGHTWEIGHT SAFETY GOGGLE features an all-plastic frame with a single plastic acetate lens which provides maximum vision. Safety goggle is recommended for wear directly over eyes or over spectacles for frontal protection against flying particles on jobs such as machine work; hand-tool operations; chemical and physical-laboratory work; spot welding; and light grinding, chipping, and riveting. Design of the durable brown plastic frame is such that it provides unobstructed side vision, excellent frontal protection, and smart appearance. No metal touches the skin. Metal temples, enclosed in acetate to prevent corrosion, are easily adjusted and hold the goggles snugly without irritation. *American Optical Co.*

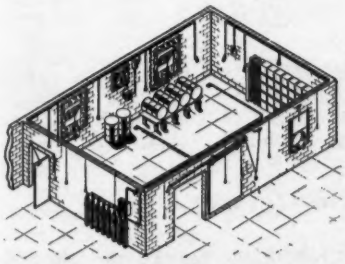
IT'S NEW CHECK IT

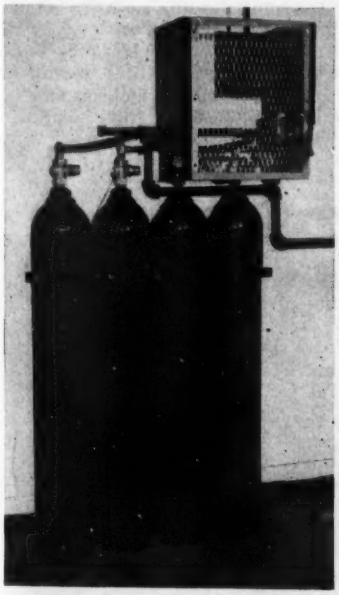
(7) TYPE "GW" PACKER CUP is used in swabbing old wells, or in wells containing strings of mixed or bad pipe. Due to the tight fit against the tubing or casing wall made possible by the properties of this flexible-lip cup, it is especially valuable in swabbing wells with a low fluid level or in taking water off gas wells. Cup does not supplant standard type "K" packer cup for routine swabbing operations. Cup is made of oil-resistant materials in sizes to fit all tubing and casing dimensions. *Guiberson Corp.*



Type "K" Cup Type "GW" Cup

IT'S NEW CHECK IT





(8) NEW CARBON DIOXIDE FIRE-EXTINGUISHER SYSTEM protects Class B and C risks requiring localized or total flooding, and rotates electrical units requiring a sustained discharge of carbon dioxide. System automatically shuts off power units, closes windows and doors when fire strikes, but only after first sounding an larm to permit employes' exit from the fire area. Then the system discharges its fire-killing carbon dioxide. It is a flexible unit, readily adaptable to all needs a fire risk requires. It can be easily installed and serviced. Additional cylinders can be quickly added should a risk be increased later to require added protection. *American LaFrance-Foamite Corp.*

IT'S NEW CHECK IT

(9) NEW CAB-OVER-ENGINE series of trucks with a total of 11 basic models have been added to the medium-duty line of manufacturer's trucks. Five models have wheelbases ranging from 122 to 197 in., a gross vehicle weight ratings of 16,000 lb. and gross combination weight rating of 26,000 lb. Gross vehicle weights for a different series are 19,500 lb. with standard rear axle and 21,500 lb. with optional heavy-duty rear axle, while gross combination weights are 34,000 and 37,000 lb. respectively. Units have builtin fresh-air ventilation system; greatly increased visibility; full adjustable seat with nearly double the number of springs; three-point rubber stabilized cab mounting; easier operating clutch and brake pedals; improved ball-bearing steering; and such other features

as ashtray, dome light, package compartment, dual windshield wipers, and provision for radio. Frames have a new nominal depth of 9 in., providing a section modulus that completely eliminates the need for reinforcements or "fishplates." Axles and heavier with increased ratings. Front springs are longer providing easier handling, and easier riding for both driver and load. Engines are the same as those used in the conventional models of like capacities. *G.M.C. Truck & Coach Division.*

IT'S NEW CHECK IT

(10) SAFETY (BACK-FLOW GATE) SWING CHECK VALVE is used to prevent the reversal of flow in horizontal or vertical pipe lines. Common application is on the downstream side of angle safety or relief valves which discharge from compressors, pumps, pressure vessels, or storage tanks. Where a group of relief valves are connected into a common discharge header which carries fumes to atmosphere or to flare, any relief valve in the group may be removed without interference with the others by turning lever on the safety check. Operator may then disassemble the angle valve and repair it without any danger of a discharge, or back surge from other angle valves popping. Valve may also be tested for leakage by installing gage to bottom pipe plug connection on upstream side of valve seat. *Daniel Orifice Fitting Co.*

IT'S NEW CHECK IT

TRADE LITERATURE

(11) CLAD STEELS. A 34-page bulletin describes Clad steels for combating corrosion in refineries, natural-gasoline plants, cycling plants, etc. Tables of recommended applications included. *Lukens Steel Co.*

IT'S NEW CHECK IT

(12) CENTRIFUGAL BLOWERS. An eight-page bulletin covers single-stage centrifugal blowers using open-type radial-blade empellers. Pictures show interior construction, packing box, and bearing details. Performance and blower-shaft horsepower curves are included. *Elliott Co.*

IT'S NEW CHECK IT

(13) PROTECTIVE CLOTHING. New pocket-size folder describes and illustrates rubber-surface work suit, heavy-duty rubber-surface work suit, neoprene-surface work suit, waders, and rubber blankets. Sizes, weights, and colors included. *Hodgman Rubber Co.*

IT'S NEW CHECK IT

(14) GAS SCRUBBERS AND COOLERS. New two-color folder describes scrubbers and coolers for plants where gases must be scrubbed, cooled, or absorbed. Diagrams show flow of gas and liquid in equipment. *Peabody Engineering Corp.*

IT'S NEW CHECK IT

(15) VALVES FOR OIL-FIELD SERVICE. New plastic-bound, 56-page catalog describes and illustrates valves for a wide range of applications where low-pressure drop and positive shutoff are desirable features. Blueprint-type diagrams show cross sections. Dimension tables and valve-operation data included. *Okadee Co.*

IT'S NEW CHECK IT

(16) STEEL ANALYSIS CHART for corrosion and heat-resisting steel shows, in tabular form, the chemical analysis of most of the stainless steels produced and usually available. Engineers and technical men will find this a valuable reference. *Globe Steel Tubes Co.*

IT'S NEW CHECK IT

(17) L. P. GAS PROFITS. A new 28-page booklet condenses the report of a 12 months' study of butane-propane dealer record-keeping problems in the liquefied-petroleum-gas industry. Booklet covers procedures for control of gas inventory, delivery expense, scheduling of deliveries, purchases and sales, installation costs, and cylinder records. Suggested forms for use in obtaining the controls are illustrated. *Ross-Martin Co.*

IT'S NEW CHECK IT

(18) PROCESS FILTERS. New bulletin describes modern engineered filtration with horizontal-plate filters. Principle of operation is illustrated in cross-sectional view of filter. Also explains design features and gives specifications. *Sparkler Manufacturing Co.*

IT'S NEW CHECK IT

(19) DESIGNER'S GUIDE FOR WELDED CONSTRUCTION. New six-page folder punched for ring binding shows proper welding symbols to simplify drafting problems. Explanation accompanies each symbol. A quick reference for all in your organization responsible for construction and welding programs. *Lincoln Electric Co.*

IT'S NEW CHECK IT

(20) BULLDOZER-SHOVEL. A versatile shovel quickly interchangeable into a bulldozer is pictorially represented in 12-page, 2-color brochure. Outstanding features and specifications included. *Frank C. Hough Co.*

IT'S NEW CHECK IT

(21) OIL-WELL CASING. Eight reasons for using Extreme Line casing and manufacturer's solution of the problems encountered in completing the deepest oil wells are featured. Another feature is casing clearance tables in three colors to distinguish Extreme Line casing dimensions from those of A.P.I. casing, and clearances between standard bits and inside of casing from clearances between couplings or joint o.d.'s and open holes. Twenty pages. *Spang-Chalfant Division of National Supply Co.*

IT'S NEW CHECK IT

(22) BEARING METALS. New eight-page, two-color bulletin gives a complete description of metals for journal bearings. Table provides a ready application reference based on average service conditions of various types of listed equipment. *Magnolia Metal Co.*

IT'S NEW CHECK IT

(23) SAFTYWELD COUPLING. New four-page bulletin describes and illustrates new coupling for joining pipeline sections quickly and securely. Installation photographs included. *Clark Goodman Supply Co.*

IT'S NEW CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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REFINING

A.C.S. Petroleum Division Will Meet in Chicago

NEW YORK.—Special attention will be given to motor fuels, high polymers, analytical methods for petroleum-type hydrocarbons, cracking, and other catalysts by the Petroleum Division of the American Chemical Society at its 113th national meeting in Chicago April 19-23, 1948.

Under the direction of Dr. Gustav Egloff, division chairman, the meetings will be held Monday, Tuesday, Wednesday, and Thursday mornings. Meetings on Monday, Wednesday, and Thursday will be held in the Stevens Hotel. The Tuesday high-polymer forum, held in collaboration with several other divisions, will be held in the Palmer House.

Among the 21 papers to be presented, excluding those in the forum, are motor gasoline octane number properties, diesel-fuel additives, catalytic cracking with silica-magnesia catalysts; conversion of diolefins to monoolefins; olefin polymerization; crcaking high-sulfur stocks with natural catalysts; study of cracking catalysts; composition of shale-oil naphtha; preparation of monocyclic aromatics; origin of petroleum as seen by recent researches; alkanesulfonic acids as polymerization and alkylation catalysts; estimation of composition, and analysis of hydrocarbons in gas oil and lube oils, and estimation of six-membered ring naphtenes.

The Petroleum Division dinner will be held on Thursday evening, North Ballroom, Stevens Hotel.

A.P.I. Group to Hear Military Lubricant Needs

The increased demand for lubricants with emphasis on the military, will be the foremost subject of interest when the Lubrication Committee of the American Petroleum Institute meets for the first time this year at the Mayo Hotel, Tulsa, April 27-28.

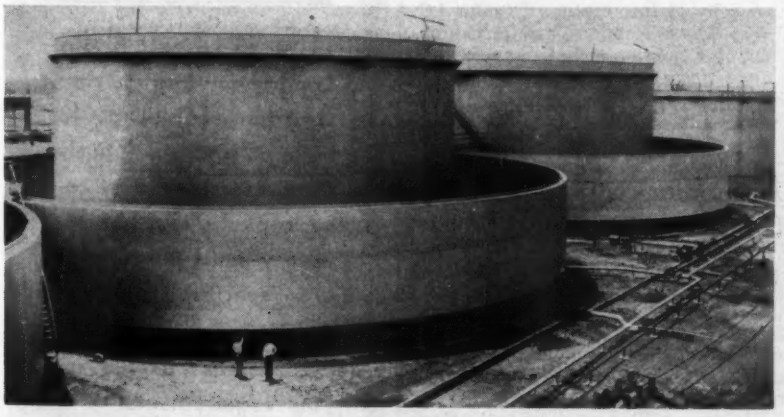
Col. G. H. Vogel, Military Services Petroleum Board, Washington, and A. J. McIntosh, Socony-Vacuum Oil Co., Inc., New York, will give addresses on this subject, according to B. G. Symon, Shell Oil Co., Inc., New York, program chairman.

Gulf Begins Construction To Up Storage Capacity

Gulf Oil Corp. has begun construction on terminal and bulk plants to increase oil storage capacity by more than 159,000,000 gal. to improve the oil-supply system in the east.

Completion of the program is ex-

STEEL FIRE WALLS FEASIBLE FOR LARGE TANKS



Feasibility of the use of steel fire walls around large storage tanks is illustrated in this photograph of installations in Sun Oil Co.'s marine terminal at Newark, N. J. Tanks shown here are 90 ft. in diameter and 48 ft. high. The fire walls are 140 ft. in diameter and 22 ft. high and are constructed of steel plates ranging from 0.25 to 0.41 in. thick with butt-welded joints. The walls, first installed in 1946, are bolted to concrete rings as bases, built on pilings. At the top horizontal plate and angle girders are used to reinforce the walls. These two tanks have floating roofs. A third tank, not shown, has a cone roof. Tanks and walls were built by Chicago Bridge & Iron Co.

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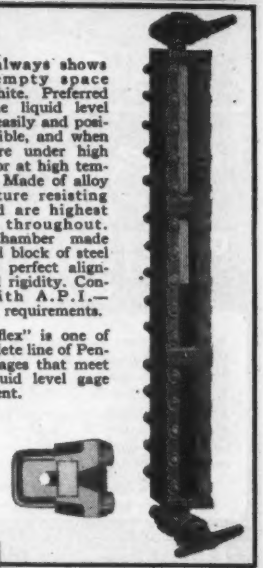

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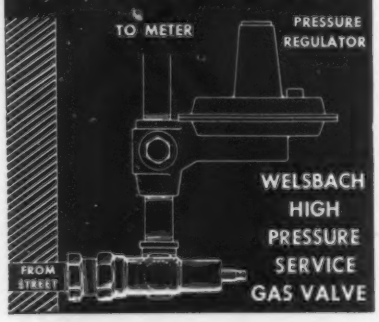

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pected by the end of next year and includes the building of tanks of 420,000-gal. capacity and up in 30 cities in 14 states. The increase will be brought about chiefly by additions to existing storage plants.

General Aniline To License Processes

NEW YORK.—Offer to license processes under the company's more than 3,500 patents has been made by Jack Frye, president of General Aniline & Film Corp. of New York. These processes include those for chemicals, photographic, dyestuff, and other products.

Abstracts of all patents will be published for the information of all prospective licensees, available in brochure form. All patents will be entered also in the U. S. Patent Office's Register of Patents Available for License or Sale, in Washington.

These new arrangements have been worked out with the Office of Alien Property of the Department of Justice, which holds more than 90 per cent of the company's capital stock. General Aniline is one of the country's largest chemical manufacturers and is considered to own one of the most extensive patent portfolios of any company in the chemical field.

Japan Wartime Liquid Fuel Made From Coal

More than 2,500,000 bbl. of Japan's wartime liquid-fuel supply was made from coal by the process known as "low-temperature carbonization," according to a recent Bureau of Mines report. Crude-oil production in Japan proper in the same period was approximately 10,000,000 bbl.

A copy of Information Circular I.C. 7430, "Low - Temperature Carbonization of Coal in Japan," may be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa.

Ammonium Nitrate Report Is Published by Bureau

Results of preliminary tests on samples of ammonium nitrate fertilizer and observations of Bureau of Mines engineers who assisted in investigating the Texas City explosions nearly a year ago are described in a new bureau publication.

The report (Report of Investigations 4245) discloses that Bureau of Mines engineers are continuing tests on fertilizer samples and will make more technical data available upon completion of the experiments.

The report may be obtained free from the publications-distribution section of the bureau.

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AT THE OIL SHOW See
BOOTHS 89, 90, 121, 122

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PIPE LINES

Humble Awards Contract For Three 12-In. Loops

HOUSTON.—Humble Pipe Line Co. has awarded contract to Sheppard-Geiger Pipe Line Construction Co. for the construction of three 12-in. loops totaling 23.46 miles between Lytle, Atascosa County, and Ingleside, San Patricio County, Texas.

Humble has a terminal and a main tank farm at Ingleside, and the construction will extend the 12-in. loops to the existing 12-in. line from Lytle. The loops consist of 6.68 miles near Campbellton, Atascosa County; 7.55 miles near Beeville, Bee County; and 9.23 miles near Sinton, San Patricio County. Preliminary work on the job started last week.

Humble Pipe Line also has let contract to Latex Construction Co., Houston, for the laying of 6.7 miles of 8 in. between Hastings and Webster in Harris and Galveston counties. This line replaces two existing 4-in. lines. Work is to commence in the near future.

Another new Humble job is the construction of an 8-in. line on a 9-mile section between Pettus and Refugio in Bee County. This replaces 9 miles of 6 in. which is being dismantled. Massey Pipe Line Construction Co., Corpus Christi, has the contract.

Skelly Laying Lines In Velma, Okla., Area

Pipe is being laid for a 26-mile gathering system of Skelly Oil Co. to supply the company's natural-gasoline plant in the Velma, Okla., area. Contract was let to D-M Construction Co.

Central Illinois Loop Contract Is Awarded

Natural Gas Pipeline Co. of America has let contract to H. C. Price Co. for a 54-mile, 24-in. continuous loop in central Illinois, designated as Schedule 6 of the company's 1948 construction program. This is the largest loop planned this year for the gas-transmission line to Chicago.

Pipe is being received now for construction operations which will start in June.

The Price organization will have a main-line spread and a river-crossing gang, according to present plans. A field office will be established at Kewanee for pipe laying, which will proceed eastward from the Geneseo compressor station. Multiple crossings will be laid at the Illinois and Mississippi Canal and the Big Bureau River.

Contracts were let to Midwestern Constructors by Natural Gas Pipeline Co. of America for two loops totaling 27.4 miles of 26-in., including 13.6 miles near Oskaloosa, Iowa, and 13.8 miles near Geneseo, Ill. Work is scheduled to start in June for completion within 60 days. M. T. (Bill) Wilhite will superintend Midwestern's operations.

Stanolind Trunk Line Looping Operations

A 46-mile 16-in. loop has been completed and tied in at a section extending from Monroe station, near Lubbock, Tex., to Childress for Stanoline Pipe Line Co.

The contractor, R. H. Fulton & Co., has moved the spread from this loop to lay a 5-mile 16-in. loop at the Bretch station, near Roosevelt, Okla., where operations are now under way. Later this spread will be transferred to lay 15 miles of 16-in. loop near El Reno, Okla., where pipe is now being unloaded.

The Fulton organization, which has a contract for a total of approximately 81 miles of 16-in. looping for Stanolind, will operate a second spread in the Drumright, Okla, area for laying a 15-mile 16-in. loop. At present in the Drumright area, pipe is being strung and work is being done on the right-of-way. As a result of the various oil field and gasoline plant operations in the Cushing field in the Drumright area, the loop to be laid will cross more than 80 lines.

The 12½ miles of 20-in. loop being laid by Midwestern Constructors for Stanolind in the Hominy-Nelagoney area of Osage County, Oklahoma is expected to be finished this month.

Sunray Completing Allen-Beckett Line

Sunray Oil Corp. is finishing the last 10 miles of pipe this week for the construction of the company's 95-mile, 6-in. line between Allen and Beckett, Okla., for the exchange of charging stock and products between two refineries of the company.

Construction has been delayed during the period of several months it

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has been in progress because of difficulties due to irregular pipe deliveries and bad weather.

Sunray has put a line in service recently for shipping charging stock from the Fen-Ter Refining Co., Wynnewood, Okla., to the company's Beckett refinery.

Work Under Way On Ohio Fuel Gas Line

Work has been started for the laying of 8 miles of 10-in. for Ohio Fuel Gas Co. in the vicinity of Mount Vernon, Ohio, which has been contracted by Midwestern Constructors. The job is scheduled to be finished April 25. Lyle S. DeWitt, superintendent for Midwestern has field headquarters at Elyria, Ohio.

Sheehan Pipe Line Construction Co. has completed the laying of 6-in., 8-in., 10-in., 12-in. and 16-in. for Ohio Fuel Gas near Newark, Ohio, which was supervised by C. D. Osbourne, Sheehan superintendent.

Interstate Completes Hico-Knowles Outlet

Interstate Oil Pipe Line Co. has completed a 9½-mile, 4-in. crude oil line to connect Hico-Knowles field, Clairborne Parish, Louisiana, with the company's Sugar Creek pump station on the system operated by the southern division.

Magnolia Has Three Spreads on Patoka Line

Magnolia Pipe Line Co. has all pipe on hand for the 650-mile 20-in. Corsicana-Patoka, Ill., crude-oil line which is scheduled for completion between May 15 and June 1.

The 170 miles remaining to be laid is being handled by three spreads of Oklahoma Contracting Co. which are working south from Conway, Ark., Doniphan, Mo., and the Mississippi River. Station construction for the project is well advanced.

Pipe-Line Movement of Motor Fuel Shows Gain

The volume of motor fuel delivered from pipe lines during 1947 totaled 244,146,000 bbl., an increase of more than 11 per cent from the 1946 total of 218,756,000 bbl.

Motor fuel turned into lines totaled 244,971,000 bbl. in 1947, a gain of slightly more than 12 per cent from the 1946 total of 218,174,000 bbl.

In December, deliveries from lines totaled 20,288,000 bbl., against 17,749,000 bbl. in the same month a year earlier and against 20,305,000 bbl. in November.

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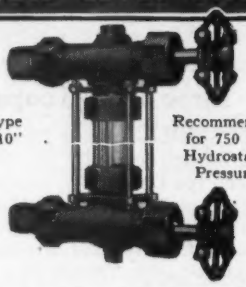

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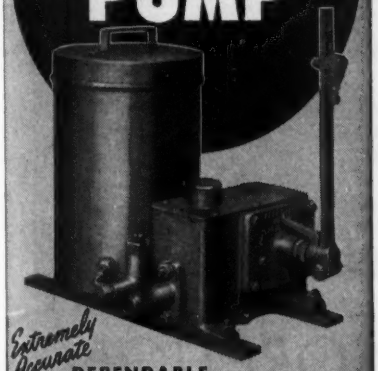

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cember totaled 21,033,000 bbl. against 18,742,000 bbl. in December 1946 and against 20,762,000 bbl. in November.

Stocks in lines and working tanks at the end of the year totaled 9,034,000 bbl., against 9,260,000 bbl. a year earlier.

Safety Practices In Laying Biggest Inch

Analyses of the accident record compiled during the laying of the Biggest Inch line (214 miles of 30-in. for Southern California Gas Co. and Southern Counties Gas Co.) shows low loss ratio. In contrast to the normal loss ratio for similar construction projects in California amounting to 60 per cent, it has been determined that the loss ratio of the contractor, H. C. Price Co., was only 32.1 per cent.

Experience of the Price organization has shown that it is advantageous to comply with safe rigging standards. Metal hats afford valuable protection for employes working around winch lines, side booms, and hoisting equipment. Goggles eliminate eye injuries for employes engaged in scaling or chipping work, helping welders, and for grinding operations.

Gas Purchase Case Set For April 16

The case involving the purchase of natural gas, originally destined for transmission northward through the Michigan-Wisconsin Pipe Line Co. system now under construction, has been set for trial April 16 when briefs will be submitted to the federal District Court in Tulsa.

This case is designated as Civil Docket 2149, Phillips Petroleum Co. vs. Skelly Oil Co. and others which include Stanolind Oil & Gas Co. and Magnolia Petroleum Co. Early this month evidence was heard and contracts, exhibits, and instruments were presented. The case is concerned with the validity of contracts, affected by the manner in which permission was granted by Federal Power Commission for the construction of Michigan-Wisconsin's line from the Texas Panhandle and Hugoton areas to Michigan and Wisconsin markets. The gas involved in the contracts was to be purchased by Phillips for delivery to the Michigan-Wisconsin system.

New Mexico System Operates 150 Miles

New Mexico Asphalt & Refining Co., Artesia, N. M., has increased its system to approximately 150 miles of 2-in., 4-in., and 6-in. lines. Officers of the corporation are A. R. Matthews, president; Walter R. Luck and C. L. Withers, vice presidents; E. W. Allen, secretary-treasurer; and Harry Plowman, superintendent.

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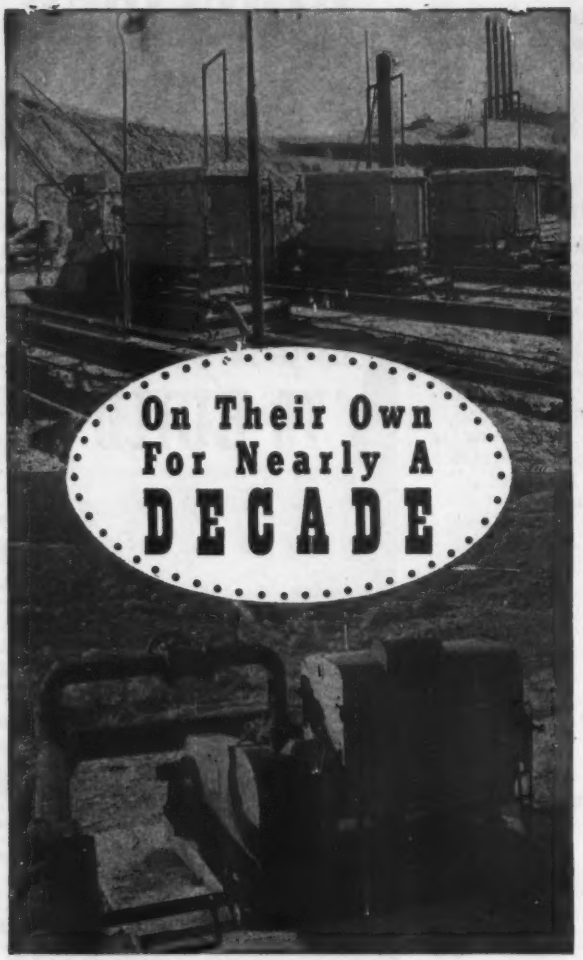

Not clocks, but calendars measure the *steady, dependable* and *economical* operation of MM Power Units. The important thing is that they are still giving the same *steady* service that established them as the *dependability and economy leaders.*

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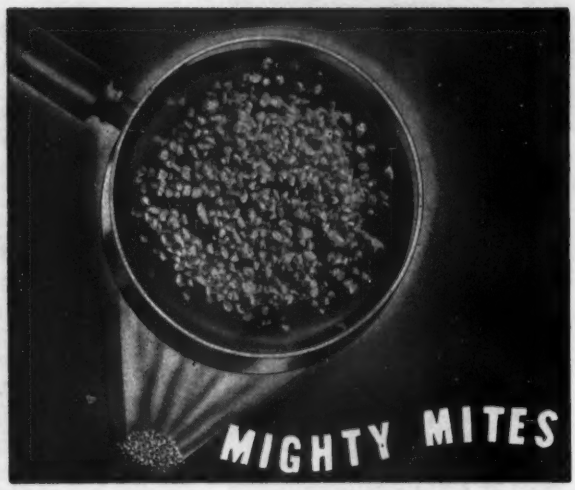

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NATURAL GAS

Record Year Reported By United Gas Corp.

HOUSTON.—United Gas Corp.'s system now totals more than 14,000 miles, connects to more than 125 producing fields in the Southwest, and during 1947 sales reached a company record of more than 420,000,000,000 cu. ft.

United Gas' annual report shows that the company's system, including main transmission lines, field lines, and distribution and service lines, provides natural gas for 300,000 industrial, commercial, and residential customers in 197 communities in the Gulf South, and that, in addition, gas service is provided at wholesale to an additional 157 communities.

The report said much new construction was necessary to meet a continued unprecedented demand for natural gas during the year. Capital expenditures totaled $20,447,000 in 1947, bringing to more than $200,000,000 the amount spent for construction, development, and replacement of properties since organization of the company in 1930.

An all-time record of more than $2,000,000 paid to gas producers by United in 1947 reflected the increased volume of gas sales, the report said. Other costs of operation also were up sharply.

Research work instituted in 1947 has been substantially expanded, the company reported. Additional space and equipment have been obtained, and the research staff doubled during the past year.

United Gas and its subsidiaries, United Gas Pipe Line Co., Union Producing Co., and Duval Texas Sulphur Co., operate in the five-state area of Texas, Louisiana, Mississippi, southern Alabama, and western Florida.

WAA to Dispose of Carbon Black Plant

Sealed bids are being accepted by War Assets Administration for the purchase of a channel-type carbon-black plant in Sunray, Moore County, Texas. It is currently operated under interim lease by Continental Carbon Co. The plant has an annual capacity of about 20,000,000 lb. of channel-type carbon black.

The property, which cost the Government $2,177,000, includes a plant site of 150 acres, a 5-acre housing site containing 20 frame dwellings for workmen, a total of six burner units, storage buildings, a processing building, and auxiliary structures. Total floor area of buildings is about 475,000 sq. ft.

Shamrock Oil & Gas Corp. is furnishing the gas on a month-to-month contract with the present lessee. The purchaser of the plant would make his own arrangements for gas supplies.

Bids will be accepted until April 7 by WAA Office of Real Property Disposal, North American Plant, Grand Prairie, Tex.

Huge Increase of Gas Use Noted in 1947

An increase of approximately 2,000,000,000 cu. ft. daily of natural-gas capacity was added during 1947, according to an analysis of the growth and potentials of the natural-gas industry in the United States which has just been completed by the National Industrial Conference Board. This is the equivalent of supplanting about 80,000 tons of coal daily or adding 29,000,000 tons on an annual basis to the coal stockpile.

Construction of new facilities during 1947 added 5,370 miles of pipe lines, bringing the total network mileage up to 229,000, or about 2,300 miles more than the mileage of trunk railroad tracks in the United States, the report said.

Natural gas accounts for more than four-fifths of all the gas used today, and nearly one-half of all the gas utilities' customers use natural gas, according to the report.

United Fuel to Acquire Kentucky Facilities

The Federal Power Commission has authorized the acquisition by United Fuel Gas Co. to acquire all the facilities in West Virginia now owned by Central Kentucky Natural Gas Co. Cost has been estimated at $1,085,000.

No rate change will result from the acquisition, United stated. United and Central Kentucky are both affiliates of Columbia Gas & Electric Corp. Central Kentucky will operate only in Kentucky.

Property included in the authorized purchase are the Kenova compressor station in Wayne County, West Virginia, together with the land, structures, measuring and regulating equipment and transmission lines extending from the station to the West Virginia-Kentucky state line, and about 53 miles of natural-gas transmission pipe lines ranging from 8 to 20 in. in diameter, together with land, land rights, structures and measuring equipment located in Wayne, Cabell, and Lincoln counties, West Virginia. All of these facilities with the exception of the Kenova station are now being operated by United under lease.

Hugoton Gas Allowable To Be Set This Week

The gas allowable for the Hugoton field for the 6-month period from April to September and allowables for individual gas wells in the Hugoton field will be determined at the monthly hearing of the Kansas Corporation Commission in Wichita March 26.

The oil allowable for April will be set at that time by the commission.

Natural Gasoline

More Data Released on Pettus Cycling Plant

CORPUS CHRISTI. — Additional data have been disclosed on plans for the Pettus cycling plant, construction of which is scheduled to get under way in April.

The plant will be operated by Stanolind Oil & Gas Co. and is expected to be completed by April 1949. Union Producing Co. will operate the producing facilities serving the plant.

Estimates now place cost of the plant at $7,259,000, about $1,500,000 more than the original figure. Capacity will be 166,000,000 cu. ft. daily with an expected production of 287,000 gal. daily of liquid hydrocarbons, including 150,000 gal. of gasoline, 119,000 of butane-propane, and 18,000 gal. of kerosine and diesel fuel. The plant is located near the Bee-Karnes county line about 7½ miles northeast of Pettus and will serve North Pettus and Burnell fields of Bee, Karnes, and Goliad counties.

Design of the plant provides absorbers operating at 1,600 psi. and six compressors with a total of 9,000 hp., including five of 1,600 hp., and one of 1,000 hp. Capacity of the boilers will be 180,000 lb. of steam hourly, and two generators will have a capacity of 3,000 kw.

Approximately 30 miles of line will be laid to gather gas for the plant. Officials of Union Producing estimate that reserves in the two fields approximate 3 trillion cubic feet. Production is from five sands from 6,500 to 8,000 ft. Anticipated life of the cycling operation is 13.3 years.

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Among the

Drilling Contractors

Mora Drilling Co. Formed To Succeed Smith-Horton

Mora Drilling Co. has been formed in Tulsa as successor to Smith-Horton Drilling Co. Partners in the new firm are Dale J. and Joe W. Smith, who bought out their former partner, LeRoy Horton.

The new contracting firm—which is named after the Smiths' New Mexico ranch—has two deep and two medium-depth rotaries running in Oklahoma. Office manager for Mora is W. R. Burris.

Current activity includes a Hughes County wildcat for its own account, the 1 Talbert, SW SW SE 35-8n-10e, now drilling, and a proposed Seminole County test, the 1 Burden, NW SE SW 23-8n-6e. Starting date for the Burden is March 26.

Terry Brings in Oiler For Cecil B. DeMille

George Terry Drilling Co. has brought in a 500-bbl. daily oiler ¾ mile northwest of Edison field, California, for Cecil B. DeMille, motion-picture producer and former radio-show director. Test is DeMille 1 Jeppi and was completed flowing 22-gravity oil, with 5 per cent water cut, through ¼-in. choke.

DeMille is planning to start immediately on a second well 1,150 ft. due west of the discovery well. Both locations are in NW 17-30s-29e.

Deep Test for Kentucky

Pure Oil Co. et al have asked for contractor's bids on 7,500-ft. wildcat to be drilled 1¼ miles southeast of Sebree, Webster County, Kentucky. Partners in the operation with Pure are Ashland Oil & Refining Co. and I. B. Browning. Well is 1 M. L. Walker, NE 22-N-24, lying south of Shawneetown-Rough Creek fault. Objective is Knox dolomite. Both rotary and cable tools will be used in drilling the hole.

Date Set for A.A.O.D.C. Meet

October 11-13 has been announced as the date for eighth annual meeting of the American Association of Oilwell Drilling Contractors which will convene in the Rice Hotel, Houston. Room reservations will be made through a committee of which Howard Phifer, L. D. Cain Drilling Co., 1117 City National Bank Building, Houston, is chairman.

Acme Drilling Co. is drilling Royalty Service Corp. 1 Mitchell, townlot area, Huntington Beach field, Califoonia.

Here are some of the men responsible for drilling the deepest well ever drilled by a contractor and the deepest test ever drilled in California. The well is Standard Oil Co. of California 1 Maxwell, 23-2n-23w, Ventura County. Stuck drill pipe forced abandonment of the well at 17,696 ft.—127 ft. short of a world record. Men in picture are: Selmer Treat, George Rowland, John Simily, H. S. Simily, crew members; J. C. Viles, driller, and Roy C. Carpenter, tool pusher, all of Rocky Mountain Drilling Co.; George A. Collins, drilling foreman, Standard of California; and Keith Bright, mud engineer, Baroid Sales Division

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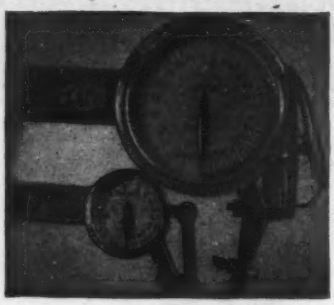

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Growth.—Davidson Drilling Co. was organized in 1927, and with its running start of three cable-tool rigs, two ahead of a good many of its early competitors, did considerable work of a pioneering nature on problems met in drilling to the Permian system in West Texas. For a time, its operations were confined to the northern end of what was later to be defined as the Permian basin. When rotary rigs succeeded cable tools for deeper work, Davidson changed and added equipment. At the present it has seven rigs, of all sizes, working throughout West Texas.

C. J. DAVIDSON

Personnel.—C. J. Davidson, president, makes his home and headquarters in Fort Worth, where he is active in a number of civic affairs. He is a director of the American Association of Oilwell Drilling Contractors. H. W. Davidson, vice president, is in charge of drilling operations, and makes his headquarters and home in Odessa. L. R. Sproles, secretary-treasurer; and Roscoe Evridge, office manager, are in the Fort Worth office. C. I. Woodroof is field superintendent.

Sidelights.—Being one of the first operators in West Texas, Davidson drilled discovery wells in many fields which later became major producing areas. Included are Bennett field of Yoakum County, where the first well was drilled on the Bennett ranch in 1935. That strike is now Wasson field. The Duggan discovery, later named Slaughter field, and now extending into Cochran, Hockley, and Terry counties, was another of the company's "firsts." Davidson has drilled over 60 wells in that area since its discovery. The concern also drilled the discovery well in the old Cummins district of Ector County, in 1928.

Wampler Drilling Co. has contract on Sells Petroleum Co. 1 Rudd & Hall, southeast outpost test to new Travis Peak sand production in eastern Harrison County, East Texas. Location is on 147-acre tract in William Grouch Survey.

Penrod Drilling Co., Shreveport, has contract to deepen Placid Oil et al 1 Scholar, C SW SE 30-6n-11w, Jones County, Mississippi. Test was abandoned by Gulf Oil Corp. at 11,157 ft. and Penrod is to deepen to about

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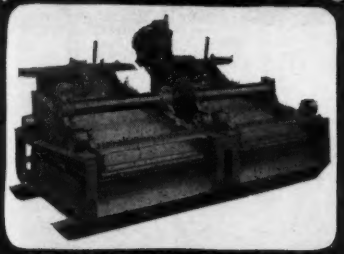

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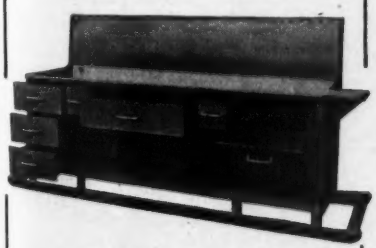

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13,000 ft. Well is south of Ovett field discovery well.

Commonwealth Drilling Co., Calgary, Alta., has contract to drill No. 1 test for Saskatchewan Federated Co-Operative in LSD 13, 35-50-26w4, in Leduc field.

E. K. Carey Drilling Co., McPherson, Kans., is below surface pipe on an 8,000-ft. wildcat 6 miles northeast of Denver. Well is R. H. Suhr, C. W. Trickett, and E. G. Fielder 1 Miller, SE NE SW 19-3s-66w. Location is on 7,000-acre block between Fitzsimmons General Hospital and Rocky Mountain arsenal.

Guy Mabee Drilling Co., Midland, has contract for The Texas Co.'s 5,000-ft. wildcat in east-central Andrews County, West Texas. This Permian exploration, scheduled to get under way immediately, is 5 miles north of Mabee field, Section 24, Block 39, G&MMB&A Survey.

Cook Drilling Co., Fort Worth, has been awarded contract by Carter Oil Co. for its 1 Gildon, wildcat in C NW NW 22-16s-27w, near Genoa, Miller County, Arkansas. Contract is for 9,000 ft. or Smackover.

Clyde Gibson. Wichita Falls, has contract for Continental Oil Co. and Phillips Petroleum Co. 1 R. L. Jackson, Block 16, Tarrant County School Lands, Wichita County, North Texas. The Ellenburger wildcat is 1½ miles east of Iowa Park.

Helmerick & Papne, Inc., Tulsa, has work under way on its 2 Quinill, SW SE SW 14-1n-1w, 6,500-ft. test, Garvin County, Oklahoma.

Meredith, Clegg & Hunt. Houston, are building road and moving in tools to drill 1 Peter Byrd for The Texas Co. in Washington County, Texas. Contract depth is 8,000 ft., and location is about 12 miles north of Brenham.

Pacific Drilling Co. has contract for two wells in Huntington Beach field, California, for estate of Louise Dabney.

Skeeter & Curry. Longview, Tex., are preparing to rig up for first of two tests to be drilled on acreage in Cimarron County, Oklahoma, which has been farmed to H. W. Snowden by Stanolind Oil & Gas Co. First test is W. F. Klein, C NE SW 5-4n-7ECM, 4½ miles northwest of Keyes. Second test is to be drilled in C SW NE 34-4n-8ECM. Both tests are to Mississippi lime.

Commonwealth Drilling Co. of Calgary, Alta, is rigging No. 1 well for Saskatchewan Federated Co-Operatives, Ltd., in LSD 13, 35-50-26w4, in Leduc field.

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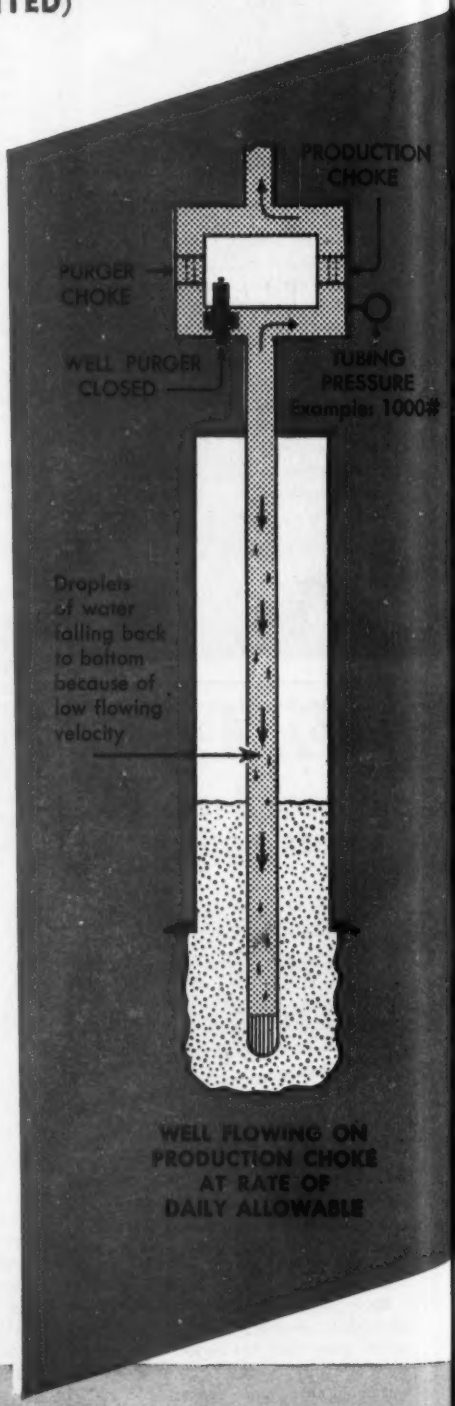
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Exploration and Drilling

A New Oil Accumulation Just West of Elk Basin

A STRIKE rated at 500 bbl. per day of high-gravity (around 43°) oil by Seaboard Oil Co. of Delaware 53-33 N.P.R.R. in NW SW NE 33-58n-100w, at Silver Tip, Park County, Wyoming, just west of the main Elk Basin field, indicates that not all of the oil in and around that field has been found yet.

The well was drilled to 9,507 ft. total depth in the Madison, before plugging back to get this production in the Phosphoria (Embar) lime section. Casing was run to 8,590 ft., and perforated at 8,496-8,516 ft., with 82 holes. The well flowed 5 to 8 bbl. per hour naturally of 43.7°-gravity, light green oil, with an ungaged amount of hydrogen sulfide gas. It was then acidized with 1,000 gal., and flowed 20 to 25 bbl. per hour, with an estimated gas flow of 7,000,000 cu. ft. daily, tubing pressure 1,650 psi., and casing pressure of 600 psi.

This is Seaboard's first operation in the Rocky Mountain region, and the location is reportedly based on an interpretation of a faulted condition west of the main Elk Basin field. On the way down, the well had an oil show on drill-stem test of the Peay sand (Frontier in Cretaceous), and the operator is now drilling another test to that horizon, 64 N.P.R.R. in SE SW NE 33-58n-100w.

The discovery, so close to the major Elk Basin field, is just one more instance of an unusual condition that seems to exist in that vicinity. In and around the Elk Basin structure, geologic conditions seem to have been favorable for the accumulation of very large amounts of oil in more than one period of geological time. These conditions seem to have been repeated at intervals at least from Mississippian into Cretaceous times, even though Cretaceous accumulations were not as rich as those in earlier ages.

One possible explanation might be that such large volumes of oil were accumulated that the renewed structural uplift in the post-Cretaceous Laramide orogeny may have simply split some of it up into areas separated by substantial faulting, without destroying the oil. The mystery of the large difference in gravity between the new Silver Tip discovery and the Phosphoria-Tensleep oil in the main Elk Basin field (a matter of 10° or more) must be chalked up as simply another instance of how little we know about what goes on in nature during either the formation or accumulation of oil.

In some respects conditions around Elk Basin may be compared to the Seeligson area of the South Texas Giant. There the accumulation of oil appears to have been so great that in exceptional cases separate accumulations are found in traps on the upthrow side of a fault zone, although most of the oil is on the downthrow side. Perhaps when nature decides to put a really rich accumulation of oil in one area, anything can and does happen.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

TEXAS GULF COAST.—At last reports, the Nichols McCaleb et al 1 Eleanor Teare, in the Dyersdale field, Harris County, was still flowing out of control, making a large volume of gas and oil through the perforated casing, and covering a wide area around the well and the Mount Houston highway with oil. Frazier 1 Hurlock, a wildcat in the Iowa Colony area of Brazoria County, started kicking while drilling at 8,724 ft. Cores taken from 8,724-44 ft. recovered sands with shows of oil, and wire-line cores for samples are being taken of the section cored and just above that level. Projected depth of the venture is 9,500 ft. Nearest production is 4 miles to the southwest in Sandy Point field.

ROCKY MOUNTAIN.—Shows of oil and gas have been encountered by Pure Oil Co. at the deep West Poison Spider wildcat, southwest of Casper. The well is at record depth for the entire region, 13,814 ft., and casing will be run. At Silver Tip, Park County, Wyoming, just west of the Elk Basin field, Seaboard Oil Co. has a 500-bbl. discovery (43.7° gravity) from the Phosphoria (Embar). It is Seaboard's first Rocky Mountain venture.

CANADA.—Leduc has been extended a full mile to the southeast by Imperial 9, LSD 16, 3-50-26w4, which produces from both the D-2 and D-3 zones. The well may indicate a swing of the field's southern producing area to the east.

NORTH CENTRAL TEXAS.—Cities Service Oil Co. has another pool opener in its 1 Schlittler, south of the Donnell field in Throckmorton County. The well flowed 33 bbl. of 41.6°-gravity oil per hour from perforations at 3,748-55 ft. Operator plans to kill the well and perforate at a deeper depth in an effort to lower the gas-oil ratio.

CALIFORNIA.—A big new wildcat play is under way, involving 14,000 acres in the Salinas Valley, San Luis Obispo County, with the first location staked in 7-25n-13w, about 10 miles east of San Miguel.

SOUTHWEST TEXAS.—San Patricio County got another new oil field, 2½ miles west of Stinton, when Morgan 1 Crabbe flowed 100 bbl. of oil per day from perforations at 5,498-5,502 ft.

PERMIAN BASIN.—Texas Pacific Coal & Oil Co. will test both the Ellenburger and Silurian at its 62-D-A Lane in McCamey field of Upton County. It has flowed 171 bbl. of oil from the Ellenburger, and is located near the only Silurian producer in the area, which failed in the Ellenburger. Sun Oil Co. is preparing to test its confirmation well of the South Jameson field in northwestern Coke County.

APPALACHIAN.—The largest Squaw sand gas well of some years was completed in the Grant district of Ritchie County, West Virginia, at Jackson 3 McGinnis & Light.

EASTERN TEXAS

Edwards Lime Test to Be Drilled Near Lufkin

DALLAS.—A second wildcat to explore the Edwards limestone in the V. Mitchell Survey, 7 miles north and slightly east of Lufkin, Angelina County, was announced this week. The new test will be Union Producing Co. 1 Bolton. Description was not readily available, but it was understood to be near the first drillsite, also on Bolton acreage, which stopped just short of the Edwards limestone, at 6,435 ft.

Another wildcat that will be watched is Seaboard Oil Co.'s proposed deep test in the Denny area, 5 miles south and west of Kosse, extreme eastern Falls County. It will be the 1 J. E. Green, on a 98-acre tract, in the Anselmo Balverdo Survey. Contract had not been let but work is to start as soon as weather and roads permit. Planned depth is 7,000 ft.

Wildcat drilling operations had little change in status, and no important oil shows had been reported. Humble Oil & Refining Co.'s deep Freestone County test, the 1 McWatters, was in sand and shale streaks at 11,236 ft. Humble's 1 Whatley was still down for boiler repairs at 5,568 ft. in shale and lime.

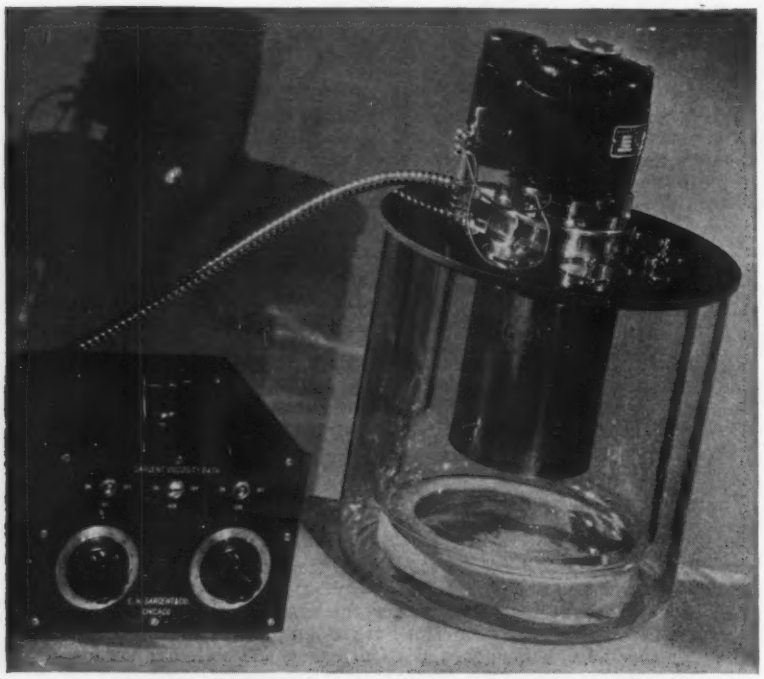
In Kaufman County, southwest of Cedarville, Shell Oil Co., Inc., 1 F. E. Lumpkin, perforated the Rodessa between 6,693-6,714 ft., and swabbed dry with no shows. On last report it was to test after acidizing perforations at 6,693-6,714 ft. In Sabine County, 1¼ miles west of Geneva, Hiawatha Oil & Gas Co. 1 Annie P. Eidom was drilling below 8,140 ft. A 40-minute drill-stem test in the James limestone at 7,785-7,811 ft., using ¼-in. chokes and no water cushion, recovered 30 ft. of mud in 30 minutes. Surface pressure was very slight, which died at the end of the test.

W. F. Nenney 1 Lone Braziel et al, Thomas Rives Survey, Smith County, was drilling below 5,151 ft. in sand and shale. Sample tops released were: sub-Clarksville 4,590-4,605 ft., Woodbine 5,053-70 ft., and Red Beds 5,085-5,100 ft. Humble 1-C Pickering, 2 miles east of Patroon, Shelby County, was coring at 7,240 ft. in shale and lime.

Seven new locations were reported last week, including three wildcats. The new wildcats were in Cherokee, Limestone and Red River counties. Hopkins, Marion, Van Zandt and Wood counties gained one location each in proven areas. Completions for the week reflect the general slump in operations throughout most of the area. Five oil, one gas and one dry wildcat made up the week's total of seven wells finished.

EAST TEXAS (DISTRICTS 5 & 6) WILDCAT FAILURE

Red River County: Garland Anthony 1 Francis Rhodes et al, W. M. Cullum Sur., ½ mi. N Avery, dry, TD 4,310 ft., Massive anhydrite 3,680-3,770 ft., by samples.



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SOUTH LOUISIANA

New Pay for S. Barataria

NEW ORLEANS.—A new producing horizon for the South Barataria field, Jefferson Parish, has been opened by The California Co. 12 E. P. Brady et al, in Section 2-16s-23e. Total depth of the well is 11,118 ft., with 7-in. oil string set on the bottom. On a 24-hour initial potential, the well flowed 142 bbl. of 52°-gravity condensate through a 5/16-in. choke with 2,850 psi. flowing pressure on the tubing, and showing gas-condensate ratio of 41,800. Production is through perforations at 9,688-9,703 ft. in a new pay zone.

Joe W. Brown 2 Valentine Sugars, in Section 46-17s-20e, opened a new producing sand for the Valentine field, Lafourche Parish. Drilled to total depth of 8,578 ft., the 7-in. production string was cemented at 8,463 ft. Perforations were made from 8,354-74 ft. for completion. On a 24-hour flow test the well flowed 66 bbl. of 55.5°-gravity condensate through a 12/64-in. choke with 3,275 psi. flowing pressure on the tubing, showing a gas-condensate ratio of 25,015. This is a new producing horizon for the north side of Valentine field.

Magnolia Petroleum Co. 1 Deshotel-Hollier Unit, Section 7-5s-1e, in Mamou field, Evangeline Parish, was completed and on initial test flowed at the rate of 86 bbl. of 49.3°-gravity oil per day with gas-oil ratio of 2,950, flowing through an 8/64-in. choke. Total depth is 11,831 ft., and the 7-in. casing is set at 11,831 ft. Production is through perforations at 11,556-566 ft.

The Texas Co. 4 State-Barataria Lease 346, wildcat exploration in the Queen Bess Island area, Jefferson Parish, township 20 south, range 25 east, is at a total depth of 15,808 ft. and is taking sidewall samples after running electrical log.

The 25 new locations reported this week included 7 wildcat starts, 1 each in Allen, Calcasieu, Cameron, East Baton Rouge, Iberville, Pointe Coupee, and St. Landry parishes. Six wildcats were dry, 2 in Lafourche, and 1 each in Calcasieu, Plaquemines, Terrebonne and Vermilion parishes. Lafourche Parish received the greatest activity showing two producers in proven areas and two dry wildcats completed.

SOUTH LOUISIANA WILDCAT FAILURES

Calcasieu Parish: Sid W. Richardson, Inc., 1 Orelene LeBleu, SW NE 23-9s-7w, SW of Iowa field, dry, TD 8,219 ft.

Lafourche Parish: Stanolind Oil & Gas Co. 2 State Lease 739, Tract 884, between Timbalier Bay and Caillou Island fields in South Timbalier Bay, dry, TD 14,147 ft.

Union of Calif. 1 Delta Security, 33-16s-18e, 4 mi. NE of Houma gas production, dry, TD 12,348 ft.

Plaquemines Parish: The California Co. 1 Louisiana State 893, 32-19s-28e, N side of Adams Bay Prospect, 6 mi. W of Quarantine Bay field, dry, TD 10,000 ft.

Terrebonne Parish: Union of California 1 State-LLE Unit 8, 21-21s-14e, on NW side of East Junop Bay Prospect, dry, TD 13,285 ft.

Vermilion Parish: Superior Oil Co. A-1 Gulf of Mexico-State Lease 884, Block 71, 22 mi. S of Fresh Water Bayou field and 19 miles south of shore line out in the Gulf of Mexico, dry, TD 13,628 ft.

N. CENTRAL TEXAS

Gainesville Test Looks Like Shallow Producer

WICHITA FALLS.—A shallow discovery in northeast Cooke County was indicated when Paul B. Scott 1 Paul Rivoire, T. G. Murphy Survey, 1½ miles west of Gainesville, recovered 130 ft. of clean oil in a 17-minute drill-stem test of a sand at 1,922 ft. Bottom-hole pressure was 600 psi., and gravity of the oil tested 38°.

In Throckmorton County, south of the Donnell field, Cities Service Oil Co. 1 Schlittler, Block 1,648, TE&L Survey, flowed 33 bbl. per hour of 41.6°-gravity oil for 9 hours, through perforations between 3,748-55 ft. in the Caddo limestone. On the 9-hour test, flow was through ¾-in. choke. Changed to 12/64-in. choke, it made 31 bbl. of oil an hour for 3 hours. Gas was estimated at slightly less than 5,000,000 cu. ft. a day. Other reports credited the well with a daily flow of 120 bbl. of oil through 7/64-in. choke, with gas-oil ratio around 7,000 cu. ft. On 5/64-in. choke the flow was 100 bbl. of oil a day, with approximately the same ratio. Operators planned to kill the well and perforate lower in an effort to lower the gas-oil ratio.

The McKnight field of southern Throckmorton County had prospects of flush production from two sections of the Caddo limestone, at James H. Snowden et al 1 Gober, Block 3, Day Land & Cattle Co. Survey. It topped the Caddo at 4,153 ft., and first drill-stem test from 4,154-64 ft., open 13 minutes, showed gas in 2 minutes, flowed oil at the end of 10 minutes and recovered 1,350 ft. of oil. The second test, from 4,164-89 ft., open 10 minutes, had flowing oil in 7 minutes and recovered 450 ft. of oil. Bottom-hole pressure was 1,790 psi.

A test of the lower section, between 4,389-4,400 ft., had flowing oil in 8 minutes, recovering 390 ft. in the pipe. Bottom-hole pressure was up to 2,000 psi. A fourth test, in the lower section, between 4,436-47 ft., had gas at the surface in 1½ minutes, blowing a spray of oil. It was allowed to blow for 50 minutes before being shut in to drill ahead. Flowing pressure was 850 psi.

In Throckmorton County, Deep Rock Oil Corp. et al 1 Andrews, 2 miles south of Throckmorton, was drilling below 4,433 ft. Saguaro Drilling Co. 1-A Herron, wildcat 2 miles southwest of Mississippi production in the Record field, was reacidized in the Mississippi at 4,774-4,813 ft., and was swabbing.

In Wise County, Cities Service 1 Berry, southwest offset to the Chico discovery, was drilling below 3,034 ft. in shale. In Clay County, Shell Oil Co., Inc., 1 Howell, 1½ miles north of Joy, was below 4,249 ft. in shale, with no shows.

New wells in North Texas (District 9), totaled 53 for the week. By counties, they were: Archer 14, Wichita 10, Cooke 8, Young

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7, Montague 6, Clay 4, Wilbarger 2, Jack 1, Baylor 1. West Central Texas (District 7-B), reported 39 starters. Shackelford led with 6, followed by Callahan and Coleman with 4 each; Haskell, Jones, Brown and Taylor 3 each; Eastland, Throckmorton and Palo Pinto 2 each; Stephens, McCulloch and Comanche had 1 each.

Completions in North Texas totaled 42 for the week, including 23 oil wells and 19 dry holes. Of this total, wildcats accounted for 1 oil well discovery and 5 dry tests. In West Central Texas completions totaled 23, including 11 oil, 1 gas and 11 dry. This included 1 wildcat oil well and 2 dry wildcats.

NORTH CENTRAL TEXAS (DISTRICTS 9 & 7-B) SUCCESSFUL WILDCATS

Archer County: L. T. & Bobby Burns 1 W. C. Jones, Sec. 1,840, TE&L Sur., 5½ mi. SW Windthorst, pumped 100 bbl. 41°-gravity oil a day, 3,211-23 ft., TD 3,236 ft.

Haskell County: Pan American Producing Co. 1 A. E. Clark, C. B. Clough Sur., 3 mi. NW Stamford, pumped 44 bbl. 36.6°-gravity oil a day, Gunsight lime 2,309-60 ft., TD 3,100 ft., PB 2,360 ft.

NORTH CENTRAL TEXAS (DISTRICTS 9 & 7-B) WILDCAT FAILURES

Archer County: Davis & Davis 1 C. L. Abercrombie, Blk. 40, J. W. Harris Subd., 11 mi. SW Archer City, dry, TD 1,468 ft. in shale.

Montague County: Houston Bowers 1 Ed Howard, Blk. 69, Kaufman CSL Sur., 4 mi. S Spanish Fort, dry, TD 3,210 ft., sand with show of oil 2,950-3,032 ft.

Chapman & McFarlin 1 Mrs. Susie Melton, Abel A. Lewis Sur., 3 mi. N Stoneburg, dry, TD 6,941 ft., Caddo 6,037 ft., Viola 6,480 ft.

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Shackelford County: H. F. Pettigrew 1 W. J. Miller, Sec. 571, TE&L Sur., 5 mi. NE Albany, dry, TD 571 ft. in sand.

Taylor County: West Central Drilling Co. 1 W. J. and C. M. Largent, Blk. 53, DeWitt CSL, 5 mi. N Merkel, dry, TD 3,094 ft., Swastika 3,040 ft.

Wilbarger County: S. D. Johnson et al 1 John Matus, Sec. 78, Blk. 14, H&TC Sur., 5 mi. S Vernon, dry, TD 4,506 ft.

Young County: Star Oil Co., Inc., 1 J. F. Hall, D. Akin Sur., 4½ mi. SE Graham, dry, TD 4,886 ft., Caddo 3,807 ft., Chester 4,688 ft., Chappel 4,794 ft.

SOUTHWEST TEXAS

New Field Opened 2½ Mi. West of Sinton

CORPUS CHRISTI.—A new oil field for San Patricio County has been opened 2½ miles west of Sinton, at Arnold O. Morgan 1 W. S. Crabb, in the J. J. Welder and Coleman-Fulton Pasture Co. Subdivision, George Morris Survey. The well flowed a reported 100 bbl. of oil per day through a ½-in. choke, with high gas-oil ratio, 1,400 psi. tubing pressure and 1,600 psi. casing pressure. Production is through perforations at 5,498-5,502 ft. Total depth is 7,485 ft., with 5½-in. casing set to 5,530 ft.

Jack Little, Trustee, and Selby-Walker Corp. 2 Albred Koenig has been completed in the north extension area of the Farenthold field, Nueces County, for a potential gage of 163 bbl. of oil per day through a 9/64-in. choke, with gas-oil ratio of 480, gravity 39°, tubing pressure 525 psi., casing pressure 1,100 psi., through perforations at 5,623-28 ft. Total depth is 5,705 ft., with 5½-in. casing at 5,640 ft. This well is in Lot 2 of O. B. Carver Tract, Casa Blanca Grant.

Wm. H. Hunt Trust Estate 5 Spencer-Kent-Crane, at Fulton Beach field, of Aransas County, has been completed in the regular pay zone, through perforations at 7,130-35 ft., flowing 232.61 bbl. of oil per day through a 5/32-in. choke, 44.4°-gravity oil, no water, with 1,150 psi. tubing pressure. Total depth is 7,174 ft., with 7-in. casing at 7,172 ft. A new pay zone for the field had been indicated when a drill-stem test at 5,288-93 ft. recovered 2,750 ft. of oil with 70 psi. working pressure in 15 minutes.

Fair & Woodward 1 Wendt, new deep discovery gas-condensate well in the Wilcox zone at North Government Wells field of northwestern Duval County, has been gaged at 2,500,000 cu. ft. of gas per day and approximately 30 bbl. of condensate per day through a ¼-in. choke, with 1,750 psi. tubing pressure, shut-in pressure 3,700 psi. Production is through perforations at 7,492-7,540 ft. Total depth is 7,800 ft., with 7-in. casing set to 7,780 ft. This well is in the J. Poitevent Survey 43, 2 miles north-northwest of Freer.

O. W. Killam 1 Marrs McLean, gas discovery well at "Quien Sabe" field, 1½ miles northeast of the North Albercas field of Webb County, has run potential gage of 35,800,000 cu. ft. of gas per day on open flow, with a light spray of oil. Shut-in pressure 535 psi. Production is through perforations at 2,314-16 ft. Total depth is 2,658 ft. with 5½-in. casing set to 2,658 ft. This well is in Las Albercas Grant, 6½ miles southwest of Bruni.

There were 41 new locations reported for Districts 1 and 4, of which 8 are wildcat starts, 3 in Milam, 2 in Starr, and 1 each in Duval, Kleberg, and Zapata counties. Seven wildcats were dry, 1 each in Bastrop, Duval, Jim Hogg, Kinney, Medina, Val Verde and Willacy counties.

SOUTHWEST TEXAS (DISTRICTS 1 & 4) WILDCAT FAILURES

Bastrop County: W. Killam 1 E. D. Fitzwilliam et al, in J. M. Bangs League, 46 mi. NE of Cedar Creek, top hard

Taylor 1,720 ft., top chalk 2,158 ft., Eagleford 2,570 ft., Buda 2,578 ft., Del Rio 2,626 ft., Georgetown 2,656 ft., Edwards 2,818 ft., dry, TD 2,820 ft.

Duval County: Argo Oil Corp. 1 Jose V. Gonzales in John S. Givens Sur. 372, 8 mi. N-NW of Benavides, 6 mi. NE of Conoco Driscoll field, dry, TD 4,378 ft.

Jim Hogg County: Hydro-Carbons Co. 1-A Marrs McLean, in Blk. 57, Sec. 6, Holbein Subd. of Share 3 of Las Animmas Grant, 15 mi. SW of Hebbronville, dry, TD 3,335 ft.

Kinney County: Dr. Charles C. Colgan 1 Whitehead & Wardlaw, in Moleton-Valdez Grant, 25 mi. SE of Del Rio, dry, TD 900 ft.

Medina County: Cannonball Hydrocarbon Co. 1 Edwin Bendele, Sur. 117, 8 mi. SW of Hondo, dry, TD 985 ft.

Val Verde County: Chas. A. Maurer 2 J. W. Ingram, EL&RR Sur. 72, Blk. S-2, 8 mi. E-NE of Langtry, and S of Pecos River, dry, TD 1,740 ft.

Willacy County: The Texas Co. 6 Yturria Land & Cattle Co., Share 4, San Juan de Carricitos Grant, 8½ mi. NE of Raymondville, dry, TD 7,503 ft.

MISSISSIPPI

Yellow Creek Offsets Are Pumpers

JACKSON.—In the Yellow Creek field, Wayne County, Humble Oil & Refining Co. B-4 G. M. & O. Land Co., south offset to the field discovery well, is pumping at the rate of 135 bbl. of 20.5°-gravity oil per day through perforations in the Morrison and City Bank sands.

Also in the Yellow Creek field, Hughes-Sistrunk-Cashion 1 S. B. Daws, west offset to the discovery, is preparing to install pump after perforating in the Morrison and City Bank sand zone. On swab test the fluid level held at approximately 2,100 ft.

In Covington County, Humble 1 Zula L. Daugherty, 28-8n-15w, swabbed salty water through perforations at 2,238-2,258 ft., in top portion of the Cap Rock. Cores in this section had shown stain of dead asphaltic oil with trace of "live" oil show. Top of salt was picked at 3,048 ft. on this new dome discovery and well was cored to total depth of 3,117 ft. in salt before setting casing to test.

Location for a west offset to the discovery well in the Pine Ridge field, Adams County, has been announced. The new Wilcox test, Phillips Petroleum Co. 3 Mrs. Vic Artman, is located 1,095 ft. west and slightly south of Phillips 1 Artman, which was completed in December 1946 through perforations at 5,618-5,622 ft. The east offset was dry, both in Wilcox and in the Lower Tuscaloosa—encountering the Artman sand 23 feet lower than in the discovery well and approximately 8 ft. below the oil-water contact established by 1 Artman.

Two wildcat starts were reported, 1 each in Copiah and Wayne counties. Eight development well locations were reported, 2 each in Gwinville field, Jeff Davis County, La Grange field, Adams and Mallalieu field, Lincoln County, and 1 each in Pine Ridge field, Adams County, and Yellow Creek field, Wayne County. The two wildcats completed were dry, 1 each in Madison and Washington counties.

MISSISSIPPI WILDCAT FAILURES

Madison County: The Texas Co. 1 Federal Land Bank of New Orleans, 34-8n-2e, dry, TD 7,586 ft. Tops: Eutaw 5,941 ft., Tuscaloosa 6,551 ft., Mid. Tuscaloosa 6,966 ft., Lower Tuscaloosa 7,275 ft., Comanche 7,526 ft.

Washington County: Union Oil Co. of California 1 Tom Johnson, 19-17n-9w, dry, TD 4,579 ft. Tops: Smackover lime

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FLORIDA WILDCAT FAILURE

Walton County: Satterlee & Adams 1 Walton Land & Timber Co., 14-1n-78w, dry, TD 2,503 ft.

GEORGIA WILDCAT FAILURE

Echols County: Hunt Oil Co. 4 Superior Pine Products Co., Land Lot 219, Land District 13, dry, TD 3,916 ft.

TEXAS GULF COAST

New Pool Opener In Austin County

HOUSTON.—Gulf Oil Corp. 1 Allen Lesiker et al, wildcat test 2½ miles east of New Ulm townsite, Austin County, has been completed for a potential gage of 45 bbl. of 38°-gravity oil per day through a ½-in. choke with 2,100 psi. flowing pressure on the tubing and a gas ratio of 2,000. Total depth is 10,017 ft., with 5½-in. pipe cemented to 10,008 ft. Production is through perforations at 9,612-18 ft.

Pan American Production Co. 1 Mordello S. Munson, new field discovery, 5 miles northwest of Angleton townsite, and approximately 2 miles east of Bailey's Prairie field production, in HT&B Survey 1, flowed on final gage 102 bbl. of fluid, 40 per cent 43.3°-gravity oil and 60 per cent salt water, through a series of chokes 7/64-in., 9/64-in., and 12/64-in. chokes. Flowing pressure on the tubing was 3,600 psi. and gas-fluid ratio was 23,093. Total depth is 11,956 ft., where it hit a strong salt water flow and stuck the drill pipe. The well is completed through 104 perforations at 10,854-880 ft.

Sunray Oil Corp. 1 Fannie O. Marshall, wildcat test 6½ miles north-northwest of Goliad, and 2½ miles east-southeast of Poehler field, in Goliad County, drilled ahead below 9,180 ft. after drill-stem test at 8,908-13 ft. in the Wilcox zone, through ¼-in. chokes, using 1,900 ft. water cushion, had steady blow for 25 minutes and recovered the cushion plus 100 ft. of condensate-cut mud and 300 ft. of muddy water cut with condensate. Bottom-hole pressure closed 3,625 psi. This well is in William Millican Survey, 5.8 miles southwest of Weesatche.

Gulf Oil Corp. opened a new deep sand off the southwest flank of the Fannett field in Jefferson County at A-3 R. S. Jackson in the W. H. Smith Survey. The well gaged 73 bbl. of net oil, 47° gravity, plus 10 per cent basic sediment and water daily through a 10/64-in. choke with 3,250 psi. pressure on the tubing and gas ratio of 49,365. Total depth is 13,502 ft., and production is through perforations at 11,045-053 ft.

The 36 new locations reported this week included 15 wildcat starts, 2 in Fayette, and 1 each in Brazoria, Burleson, Calhoun, Fort Bend, Hardin, Jackson, Lee, Matagorda, Montgomery, Newton, Orange, Washington and Wilson counties. Two successful exploratory wells opened one new oil field in Brazoria County and one condensate new pay in South Mayes field, Chambers County. Six wildcats were dry, 2 each in Live Oak and Wilson, and 1 each in Brazoria and Orange counties.

TEXAS GULF COAST (DISTRICTS 2 & 3)
SUCCESSFUL WILDCATS

Brazoria County: New oil field—Pan American Production Co. 1 Mordello S. Munson, in HT&B Sur. 1, 5 mi. NW of Angleton townsite, 2 mi. E of Bailey's Prairie field production, TD 11,956 ft., top sand 10,854 ft., perf. 10,854-880 ft., IP: 102 bbl. oil per day through 7/64-in. choke and 9/64-in. choke and 12/64-in. choke, GOR 23,093, gravity 43.3°, TP 3,600 psi., 60 per cent water.,

Chambers County: New condensate sand South Mayes field—Humble Oil & Re-

fining Co. 1 South Mayes Unit 1, in E. H. R. Wallis Sur. and D. Richardson Sur. A-212, TD 12,100 ft., perf. 12,021-026 ft., IP: 134 bbl. condensate per day through ⅛-in. choke and 1,344,000 cu. ft. gas per day, GCR 10,000, TP 5,500, gravity 42.9°, no water. This is deepest production in state of Texas.

TEXAS GULF COAST (DISTRICTS 2 & 3) WILDCAT FAILURES

Brazoria County: H. L. Hunt 1 L. M. McIlvain, in M. O'Donnell Sur., 3 mi. S of Alvin townsite, dry, TD 10,025 ft.

Live Oak County: Henshaw Bros. 1 A. H. Lamprecht, 5½ mi. NE of Oakville, in SW part of Subd. 5 of Chas. R. Tips Subd. of Dilworth Ranch, in W. Gilmore Sur. 150, dry, TD 2,826 ft.

Ryan, Hays & Burke and Alaska Steamship Co. and Newman Bros. 1 Reeves Brown, in Patrick Nevin Sur., southeastern part of county, 10 mi. NW of Mathis, dry, TD 4,510 ft.

Orange County: McCarthy Oil & Gas Corp. 1 K. W. Stephenson et al, in R. Ballew Sur., in Echo area, 8 mi. NE of Orange field production, dry, TD 8,443 ft.

Wilson County: Henshaw Bros., O. R. Mitchell & E. H. Smith 1 Dr. H. C. Woods, in Maria Calvillo Grant 22, 3½ mi. S of Floresville, dry, TD 3,910 ft.

Sunray Oil Corp. 1 R. C. Danaho, in Joseph Reynolds Sur., 5½ mi. NE of Floresville, dry, TD 7,510 ft.

CANADIAN FIELDS

One Mile Southeast Extension for Leduc

CHATHAM.—An important extension of the Leduc field a full mile to the east on its southerly limits is indicated by Imperial 9, LSD 16, 3-50-26w4, finished at 5,466 ft. with production in both the D-2 and D-3 zones. Drill-stem test at 5,416-26 ft. showed 780,000 cu. ft. gas with oil reaching the surface in 13 minutes. At 5,426-36 ft. the test showed 440,000 cu. ft. with oil in 17 minutes, recovery being 2,610 ft. of oil and 630 ft. of salt water. Water was plugged off and the well is being placed in production. Location is about a mile south and east of Imperial 34, the only dry hole yet completed by that company in the Leduc field, and it is thought the new completion may indicate an easterly swing of the producing area to the south.

In the main field, Atlantic Oils 3, LSD 12, 23-50-26w4, which blew in at 5,267 ft. while trying to deepen in the D-3 zone with 50,000,000 cu. ft. of gas and a heavy flow of oil, is under control, and testing. The well blew open for 37 hours, at 200 bbl. an hour. About 3,500 bbl. from the blow has been recovered.

Woodbend.—In the Woodbend extension of the Leduc field, 3½ miles to the northwest, Imperial-Woodbend 2, LSD 4, 15-51-26w4, is drilling, and Imperial 3, LSD 9, 16-51-26w4, is moving in equipment. Most advanced test is Continental Leduc 3, LSD 12, 7-51-26w3, below 2,079 ft. Continental 4 has location in LSD 14, 7-51-26w4.

Pouce Coupe.—Preliminary work will be started this spring by Imperial Oil in a triangular area in northwest Alberta extending from Pouce Coupe to Spirit River and Fairview. The area is related to that in which Imperial-Pouce Coupe 1, a gasser, was drilled more than 20 years ago.

Northern Alberta.—Two new tests in the plains area north and east of the Leduc field are being started by Imperial Oil. In the Volmer area, south of Morinville, Imperial 1 Volmer, LSD 2, 16-55-25w4, has spudded. Southeast of Legal, Imperial 1 Fedorah, LSD 13, 22-57-23w4, is rigging. Imperial recently completed unsuccessful tests in both the Morinville and Legal areas, but indications were felt sufficient to justify further testing.

Gaspe.—In the Gaspe Peninsula of Quebec, three tests are believed close to potential producing horizons. Venture 2, on the Galt anticline, bottoming at 2,132 ft. has a fishing job, following caving, after penetrating the limestone at 2,010 ft. The prospective oil zone is estimated at 2,400 ft. Imperial-Gaspe 1, on the Bald Mountain anticline, is below 2,810 ft., and preparing to cement casing in white limestone overlying the coral reef horizon of the Silurian formation, where first production is expected. C.P.L. 1, on the Galt Brook Dome, bottoming at 2,728 ft. is standing, with considerable gas forcing itself through a 2,000-ft. column of water. Gas, coming between casing, is believed to originate in a zone sealed off with 10¾-in. at 2,137 ft. Some oil was encountered near bottom and has accumulated in the hole in undetermined quantity, and an additional outfit is being secured to complete the well.

MICHIGAN

Beaver Creek Well Best for The Week

SAGINAW.—A 150-bbl. Pure Oil Co. producer, completed at 4,364 ft. in Beaver Creek Township, Crawford County, was the best of three wells in Michigan last week as nine completions were recorded and 10 new locations announced.

The other producers were inconsequential ones in Deep River, Arenac, and Tallmadge of Ottawa. Three of the wildcat failures were in Allegan County, scene of four new locations. Others are in Monroe, Saginaw, Kent, Crawford, St. Clair and Bay.

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MICHIGAN WILDCAT FAILURES

Allegan County, Casco Township: Norman L. Stevens 1 Clark, NE NE SE 36-1n-16w, dry in Traverse, TD 1,220 ft.

Overisel Township: W. E. Wyse 1 Kooicker, SE SE SE 30-4n-14w, dry, TD 925 ft.

Salem Township: Leonard C. Sleep 1 Weaver, SE SE SE 19-4n-13w, dry in Traverse, TD 1,652 ft.

Oceana County, Grant Township: Dale M. Leonard 1 Hule, NW NW SW 12-13n-17w, dry in Dundee, TD 2,726 ft.

LA.-ARK.

Bossier Test Cores Oil Shows

SHREVEPORT.—M. T. Halbouty and Stanolind Oil & Gas Co. 1 Bolinger-Boyd, NE NE 30-23n-12w, Bossier Parish, was drilling below 3,437 ft. after coring several shows of oil. Cores between 3,133-53 ft., in sandy shale, had a slight odor. Between 3,203-23 ft. the recovery was 19½ ft., of which the top 4 ft. was fine sand with oil odor and stain, and the bottom 7 ft. was shale with streaks of sand, having a fair odor and stain. A drill-stem test between 3,204-23 ft., open 30 minutes, recovered 30 ft. of mud having a trace of oil, and salt water. Location of the test is 2½ miles east of the Plain Dealing field.

In Bienville Parish, Union Producing Co. and Pure Oil Co. have gone back into their 1 L. P. Frazier, gas-distillate discovery in the James limestone, for further testing. The well was completed last October from perforations between 6,730-52 ft., after drilling to the Travis Peak at 8,523 ft. Completion potential, calculated open flow, was around 11,000,000 cu. ft. of gas a day. Operators retreated the James lime last week with 2,000 gal., and reported an estimated daily open flow of 18,000,000 cu. ft., with a spray of distillate. Union and Pure's 1 Nebo Oil Co., wildcat failure in 30-14n-5w, was still above the old total depth, in drilling below 7,535 ft.

In Lincoln Parish, Carter Oil Co. 1 Matthews, 22-18n-4w, was drilling below 9,046 ft. Drill returns at 8,990-9,002 ft. had a slight show of gas, but a 1-hour drill-stem test of the interval recovered 30 ft. of mud, with no shows. Operators reported 5 additional drill-stem tests between 9,026-46 ft., all of which failed.

In DeSoto Parish, The Texas Co. 1 Rambin, 23-11n-11w, was drilling below 7,070 ft. It cored black to gray shale at 6,829-46 ft. Sample top on the Travis Peak was 6,660 ft., with driller's top at 6,318. Elevation is 140 ft. In Claiborne Parish Martizky & Bibby 1 W. C. Richardson, 23-22n-6w, had total depth at 3,119 ft., and stopped to run electrical survey and cut side-wall cores. Continental Oil Co. 1 Pardee Co., 30-12n-6w, Natchitoches Parish, was drilling in Travis Peak at 8,625 ft.

Shell Oil Co., Inc., 1 Frost Lumber Co., 15-22-1e, Union Parish, was drilling at 8,451 ft. in the Cotton Valley. A drill-stem test between 8,312-32 ft., using ¼-in. chokes, and no water cushion, recovered 360 ft. of mud and 270 ft. of salt water in 10 minutes. In Webster Parish, Hunt Oil Co. 1 A. C. Burns, 16-23n-9w, was drilling at 6,650 ft.

In Columbia County, Arkansas, Robert W. O'Mears et al 1 T. F. Moody, 12-16s-22w, was about ready to start testing the Smackover, in which it logged top of porosity at 7,229 ft. Casing was recemented and perforations between 7,242-48 ft. were squeezed. Petersen Drilling Co. 1 H. L. Curry, 5-16s-19w, a semiwildcat, confirmed total depth at 3,580 ft., and was waiting on orders.

In Nevada County, Caddo Oil Co., Inc., 1 G. H. Cristopher, SE SE SE 9-11s-22w, had total depth in the Eagle Mills at 4,752 ft. It was to drill ahead, being delayed by a fish job for twisted off drill pipe. In Saline County, Don M. Fitzwater et al Malvery Lumber Co., 12-3s-16w, was thought to be

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in the Igneous at total depth of 660 ft. It was shut down for orders.

North Louisiana reported 16 new locations for the week. In Union County, the Ora field received six, Monroe two, and two wildcats. Balance of new work was: Caddo one, Franklin one, LaSalle two, Lincoln one, and Wesbter one. Arkansas' six new starts were: Columbia two, Lafayette one, Miller one, Ouachita one, and Union one.

North Louisiana's completions totaled 22, 17 oil and 5 dry. Three of the failures were wildcats. The Caddo field accounted for nine shallow producers, and the Ora field reported four.

NORTH LOUISIANA WILDCAT FAILURES

Claiborne Parish: Carter Oil Co. 1 Conway Gandy, SW NW 28-19n-7w, dry, TD 11,007 ft., elev. 359 ft.

Sabine Parish: E. C. Johnston 1 Dueroy-Rains, NE SE NE 18-9n-11w, dry, TD 3,575 ft., slight show gas 3,204 ft.

Winn Parish: Delta Drilling Co. 1 Tremont, SE SE 15-10n-1w, dry, TD 7,388 ft., Arkadelphia 4,485 ft., base annona 4,936 ft., Austin 5,771 ft., Tuscaloosa 6,056-6,360 ft., Marine Tuscaloosa 6,360 ft., Paluxy 6,880 ft., elev. 98 ft.

ARKANSAS WILDCAT FAILURE

Little River County: Lee & Burnett 1 J. L. Messamore, SE NE NE 12-12s-30w, dry, TD 2,754 ft.

APPALACHIAN FIELD

Unusually Large Gas Well Completed in Squaw Sand.

PITTSBURGH.—In Grant district, Ritchie County, West Virginia, R. C. Jackson completed a large gas well in the Squaw sand in No. 3 McGinnis & Light with a final gage of 15,000,000 cu. ft. of gas from a total depth of 1,960 ft. This is the largest Squaw sand well of recent years and was initially reported at 17,000,000 cu. ft.

On Preston anticline in Kingwood district, Preston County, Hope Natural Gas Co. has staked a location for an important wildcat on Frank F. Barlow farm which starting at an elevation of 2,235 ft., the venture on the Kingwood Quad 500 ft. east of 79 degrees 45 minutes and 8,900 ft. south of 39 degrees 30 minutes. The structure is large, having a closure of at least 350 ft. and parallels, and is between Chestnut Ridge to the west, on which a deep test was dry, and the Briery anticline to the east, on which a new gas pool has been found with the gas struck in the Corniferous chert and the Oriskany sand.

In Elk district, Kanawha County, Gregory Krebbs, Agent, completed at 1,156,000 cu. ft. gas well in the Oriskany test on G. W. White lease from a total depth of 5,111 ft. Here, United Fuel gas Co. topped the Corniferous lime at 4,991 ft. from an elevation of 1,395 ft. in the No. 6,263 J. S. Burger.

New locations in the state totaled 10 and were in Union district, Barbour County; Ravenswood district, Jackson County; Harts Creek district, Lincoln County; Logan district, Logan County; Kingwood district, Preston County; Clay and Grant districts, Ritchie County; Harper district, Roane County.

In Washington Township, Indiana County, southwest Pennsylvania, Peoples Natural Gas Co. completed a good well in No. 3 Nancy Yoeman which gaged 852,000 cu. ft. gas from a depth of 3,038 ft. New locations in this area totaled six and were in Kittanning, Plum Creek and South Bend townships, Armstrong County; Porter Township, Clarion County; Washington Township, Indiana County.

SOUTHWEST PENNSYLVANIA SUCCESSFUL WILDCAT

Armstrong County, South Bend Township: C. E. Louden, Jr., 1 S. D. Peterman, 539,000 cu. ft. gas, Murraysville and Hundred Foot, TD 1,602 ft.

WEST VIRGINIA SUCCESSFUL WILDCATS

Kanawha County, Elk district: Gregory Krebbs, Agent, 14-5 G. W. White, 1,156,000 cu. ft. gas., elev. 668 ft., Corniferous lime 4,952 ft., Oriskany 5,088 ft., shot 5,088-5,108 ft., rock pressure 1,535 psi. 20 hours, TD 5,111 ft.

Mason County, Cologne district: Columbian Carbon Co. 994 E. F. Durst, 84,000 cu. ft. gas, Big lime 1,440 ft., Injun 1,690 ft., Berea 2,144 ft., shot 3,240-3,660 ft., TD 3,750 ft.

WEST VIRGINIA WILDCAT FAILURE

Braxton County, Otter district: Morris & Burns 1 Ernest Knight, dry, Injun sand, TD 2,200 ft.

ROCKY MOUNTAIN

Deepest Well in Region May Make a Producer

DENVER.—Possibility of production in the Pure Oil Co. deep West Poison Spider wildcat was indicated this week when shows of oil and gas were encountered, probably in the Frontier sand, at 13,814 ft., total depth. This well, 1 Unit, NW SE 11-33n-84w, Natrona County, Wyoming, is now the deepest to be drilled in the Rocky Mountain region, and is based on seismic work done by Pure in the area in the past 2 years. It is reported from Casper that Pure encountered saturation and had shows of gas in the mud at total

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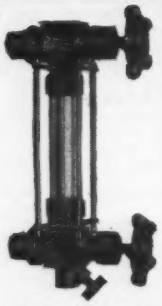

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depth, and the operator is now conditioning mud, preparing to drill ahead another 10 or 15 ft. prior to running casing and testing.

No official announcement has been made by Pure of the formations encounterd or of the present shows of oil and gas. Shows of oil were reported between 10,381-10,396 ft., probably in the Benton, and a drill stem test at 9,175-9,245 ft. recovered oil-cut mud and shows of gas.

This wildcat is located in the southeastern section of the Powder River Basin, approximately 40 miles west of Casper. The well is in a deep, thick sedimentary section of the Basin. An indication of the thickening is furnished by comparison with the Poison Spider field, 12 miles east, which produces oil from the Sundance and where granite has been found at 4,100 ft.

Discovery of oil in this deep wildcat will result in still more exploratory activity in the Powder River Basin, which has currently been very active as a result of the recent discovery of oil in The Texas Co.'s Adon wildcat in the center of the Basin, 150 miles northeast of Casper.

Pure has also found saturation in another wildcat in the Powder River Basin, at Rocky Point, Campbell County, Wyoming. Top of the Minnekahta was found at 5,342 ft. and Minnelusa at 5,407 ft. A drill-stem test in the Minnekahta showed oil-cut mud, and cores recovered in the Minnelusa (Pennsylvanian) showing staining. The well is now at 5,463 ft., total depth, and the operator is preparing to drill-stem test the Minnelusa section. This well is 1 Unit, center Lot 9, Section 34-56½n-69w, on a 2,722-acre unit completed by Pure early this year.

In 1940 Continental Oil Co. drilled a dry hole in the NE SW SE 4-56n-69w, to 6,105 ft., total depth, in the Madison formation. Small shows of dead oil were encountered in the Minnelusa but the well was not commercial. This Pure well is of importance as the second wildcat to find Pennsylvanian saturation in the Powder River Basin recently. The Texas Co. Adon wildcat, southwest in the center of the Basin, was completed a month ago for 250 bbl. of oil daily from Minnelusa, and leasing activity in the Basin has been extremely active since this discovery.

A new discovery for Wyoming is being completed by Seaboard Oil Co. of Delaware at Silver Tip, Park County, Wyoming, west of the Elk Basin field. The well is 53-33 NPRR, NW SW NE 33-58n-100w, and was drilled to 9,507 ft., total depth, in the Madison, before plugging back to 8,558 ft., where it produced 25 bbl. of 43.7°-gravity oil per hour after acidizing. The well is estimated good for more than 500 bbl. of oil daily with 7,000,000 cu. ft. of gas through choke. Production is from the Phosphoria where casing was perforated between 8,496-8,516 ft. with 82 holes.

This operation is Seaboard's first Rocky Mountain test, and the operator is now drilling another well on the structure as a test of the Frontier (Peay) sand, which showed saturation in the discovery well. Madison and Tensleep formations were hard and tight in the first wildcat although the Tensleep showed some hydrogen sulfide gas. Stanolind Oil & Gas Co. is now drilling an important wildcat well 12 miles south of the new discovery, on the Big Sand Coulee unit in the SE NE 8-55n-100w. This latter well is now below 4,500 ft. with Phosphoria as the objective.

Amerada Petroleum Co. and Carter Oil Co. are now abandoning their wildcat test at Stewart Creek, Sweetwater County, Wyoming, at Well 1 Ruddy C-164, SW NE 14-24n-90w, in the Fort Union (Tertiary). Fort Union was topped at 4,310 ft. and the well was drilled to 6,006 ft., total depth. Cores in the Fort Union recovered developed sands, but no shows of or gas were encountered. Slight traces of gas were found in upper Tertiary beds, but these were not commercial.

New operations.—Nineteen new locations were made, with 7 in Wyoming, 7 in Colorado and 5 in Montana.

Twelve wells were completed in the Rockies during the week, of which 6 were in Wyoming, 4 in Montana and 2 in Colorado. Total daily initial production for the completions was 1,131 bbl. of oil. Two small wildcat failures were listed for Wyoming.

WYOMING WILDCAT FAILURES

Big Hollow, Albany County: Empire Corp. 7 Fuller, CEL SW SE 7-15n-75w, 2,753 TD, abnd., Muddy 797, Dakota 921, Morrison 1,057, lower Sundance 1,427, Jelm 1,486, Chugwater 1,595, Forelle 2,256, Casper 2,695(?), elev. 7,228.

Crystal Creek, Big Horn County: Iris Oil 1 Government, C NW NW 8-54n-93w, 1,031 TD, abnd. Phosphoria 705, Tensleep 1,020, water., elev. 4,150.

OKLAHOMA

Prospects Good for Pool Opener in Lincoln County

FALCON SEABOARD DRILLING CO. and L. W. Barrett 1 Bierman, NE NW NE 30-13n-5e, Lincoln County, on a test of the Wilcox indicates a new pool for the area. The test was at 4,991-5,001 ft., and with the tool open for 25 minutes the operator recovered 450 ft. of oil and 150 ft. of oil-cut mud. The well had 450 lb. flowing pressure and at the end of 10 minutes the shutin pressure

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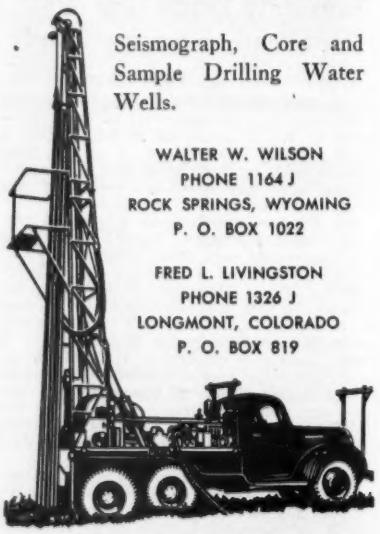

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was 2,100 lb. and increasing. The 1 Bierman is near the 1942 Wilcox test, Portable Drilling Co. 1 Barnes, that was drilled to 5,001 ft. and several perforations made without locating Wilcox production. The 1 Barnes was later taken over by Midstates Oil Co. and completed in the Prue sand after plugging back to 3,660 ft.

Mid-Continent Petroleum Co. 1 Ruby Harris, SE SE NW 29-9n-3w, appears to be an extension of the Southeast Newcastle pool into Cleveland County. The 1 Harris topped the Hunton at 8,746 ft. and had drilled to 8,778 ft. when the drill-stem test was made. With packer set at 8,743 ft. and tool open for 1¼ hours, the well had a show of gas in 9 minutes and a recovery of 3,600 ft. of clean oil. The well will be drilled deeper in the formation before casing is set.

Tide Water Associated Oil Co. has the second favorable show at 1 South Marlow Unit, C SE SW 27-2n-7w in Stephens County. A drill-stem test was made at 8,205-29 ft. for 37 minutes with a 1,900 ft. water load. Crew recovered 100 ft. of mud-cut condensate, 270 ft. of gas-cut mud and water load, and 90 ft. of heavy condensate and gas-cut mud. On a previous test at 7,898-7,913 ft. the well had shown distillate and foamy mud. Operator is coring ahead.

Out of the several wells being tested in the Ceres area in Noble County, Fourdee-Rhodes Oil Co. and Charles Walbert et al 1 Burnsides, NW NE SE 35-23n-1w, has shown as one of the bigger producers. The well flowed 161 bbl. of oil in 1 hour through 1-in. choke from the Bartlesville at 4,395-4,460 ft. before being shut in because of separator trouble.

OKLAHOMA SUCCESSFUL WILDCATS

Major County: Superior 1 Jackson, NE NE NW 34-22n-10w, flowed 41 bbl. of oil per day from Manning at 6,705-43 ft., TD 6,732 ft.

Seminole County: Extension to North Wewoka—Ligon 1 Lasiter, SE NW SE 4-8n-8e, pumped 70 bbl. of 39°-gravity oil per day from Cromwell at 3,266-76 ft., TD 4,020 ft.

Stephens County: New pay in Sholem Alechem—Magnolia 5 Martin, SW NE NE 13-1s-4w, pumped 246 bbl. of 34.9°-gravity oil per day from sands at 4,670-90 ft., TD 5,426 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: Cities Service 1 Phillips "C," NE SW SE 20-3s-11w, dry, TD 2,034 ft., Megargle 1,994 ft.

Hutcheson 1 Zweizchec, SE NE NE 20-3s-12w, dry, TD 2,010 ft., no shows.

Creek County: Barnsdall 1 Finch, NW NW NW 20-16n-10e, dry, TD 2,863 ft., Basal Bartlesville 2,569 ft.

McIntyre 1 Bird, NW NW SW 12-18n-10e, dry, TD 2,388 ft.

Hughes County: Carey 1 Hill, SE SE NW 19-9n-9e, dry, TD 4,000 ft., Cromwell 3,454 ft., Cromwell sand 3,480-3,514 ft. with no show, Mayes 3,730 ft., Woodford 3,927 ft., Misener 3,962 ft., Hunton 3,970 ft.

H. T. & M. 1 Dascom, SW SW SW 25-5n-9e, dry, TD 4,551 ft., sand 395-421 ft., Hartshorne 2,922-53 ft., Gilcrease 3,690 ft., Wapanucka 4,121-4,222 ft., Cromwell 4,532 ft.

Lincoln County: Trigg 1 Wheeler, NE NE NW 9-16n-5e, dry, TD 4,045 ft., Big lime 3,255 ft., Oswego 3,335-3,405 ft., sand 3,710-25 ft., brown lime 3,915 ft., Mississippi lime 4,015 ft.

Murray County: White Eagle 1 Greer, SW NW NW 28-1n-2e, dry, TD 2,215 ft., no shows.

Osage County: Oliphant 1 Osage, NE NE NE 9-25n-3e, dry, TD 3,611 ft., Burgess 3,514 ft.

Seminole County: Big Bear 1 England, SE SW NW 15-7n-6e, dry, TD 4,730 ft., Wapanucka 3,493 ft., Cromwell 3,528-66 ft., 3,584-3,622 ft., 3,650-3,708 ft. and 3,712-33 ft., Caney 3,827 ft., Mayes 4,165 ft., Woodford 4,230 ft., Sylvan 4,433 ft., Viola 4,456 ft., dense 4,515 ft., Wilcox 4,596 ft.

Tillman County: Langford 1 Hinder, SW SW SE 1-2s-16w, dry, TD 1,725 ft.

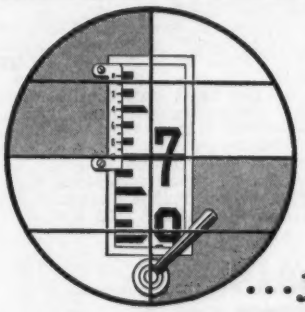
CALIFORNIA

Big Play To Open In Salinas Valley

LOS ANGELES.—A new wildcat play involving approximately 14,000 acres of ground in the Salinas Valley of San Luis Obispo County soon will be undertaken by a group of companies including Barnsdall Oil Co., Oceanic Oil Co., Bankline Oil Co., Occidental Petroleum Corp., E. B. Hall and others. The first venture in the new play has been staked in 7-25n-13w, about 10 miles east of San Miguel. This location is near a wildcat drilled about a year ago by the same group of companies. The prior test went to a total depth of 3,405 ft. without encountering anything of commercial significance. It is reported to have had some interesting showings, however.

Continental Oil Co.'s three wildcats in Kern County, which have attracted considerable attention but which have not yet turned up showings of importance, continued to drill ahead during the past week. In the San Emigdio area, the L-2 K.C.L., 8-11n-21w, is coring below 12,927 ft., while the 1 Santiago, 8-11n-22w, is drilling below 9,342 ft. In the Buena Vista area, the O-1 K.C.L., 9-31s-36e, is drilling at 7,553 ft. The company believes that these three wells are so located that they will give an accurate stratigraphic picture of a large potential oil producing area.

Drilling & Production Co. has extended the Tejon field a few locations to the northeast with completion of the 77-32 J.V., 32-11n-19w, Kern County. The well was finished flowing at the rate of 100 bbl. daily through 2½-in. tubing. Gravity was reported to be 16.0° and water cut 2 per cent. The well was drilled to a total depth of 2,627 ft. from an elevation of



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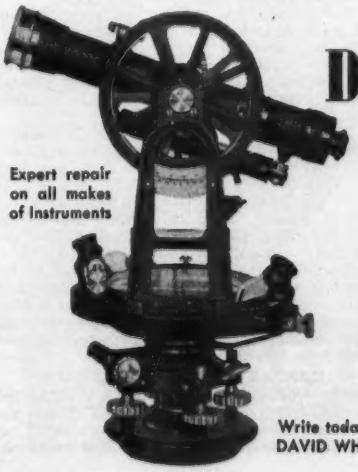

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1,060 ft. The Tejon field consists of two accumulations separated by an undeveloped area about ¾ mile in width. The 77-32 J.V. lies in this undeveloped area and is a slight extension of the western accumulation. Several dry holes have been drilled at the western end of the eastern accumulation but subsequent drilling has proved that these do not define the field limits. It is quite probable, therefore, that future drilling will prove the two accumulations to be one large reservoir.

CALIFORNIA WILDCAT FAILURES

Kern County, Comanche Point area: Crevolin & Novelli 1 fee, 32-12n-18w, dry in basement, Santa Margarita 874 ft., Fruitvale 1,418 ft., Olcese 1,744 ft., basalt 1,912 ft., granite 2,260 ft., TD 2,296 ft.

Reid Exploration Co. 1 Tejon, 32-12n-18w, dry, elev. 788 ft., TD 3,556 ft.

Grapevine-Tejon area: Richfield Oil Corp. 22-1 Tejon "A," 1-10n-19w, dry, elev. 937 ft., TD 3,516 ft.

Kern River area: L. C. Gould 1 Goodrich, 17-29s-28e, dry, elev. 434 ft., Santa Margarita 2,728 ft., TD 3,001 ft.

Shale Hills area: Independent Exploration Co. 1 Gravett, 32-27s-19e, dry, elev. 1,111 ft., Point of Rocks 1,306 ft., TD 1,540 ft.

Orange County, Santa Ana Gardens area: Tide Water Associated Oil Co. 1 Martin, 21-5s-10w, dry, elev. 47 ft., formation test 6,200-90 ft., recovered salt water with some oil, TD 6,554 ft.

San Luis Obispo County, Cuyama Valley area: Anderson et al 1 Hadley, 25-11n-28w, dry, elev. 1,791 ft., TD 2,165 ft.

KANSAS

Renewed Leasing Activity In Brown County

THERE has been considerable leasing activity in the western part of Brown County following the completion of the Stout-Hahn 1 Livengood, SW NE SW 3-1s-15e. The well has been completed for an estimated 40 bbl. of oil per day plus 300 bbl. of water. The Mississippi lime was cut at 2,224 ft. and the Hunton at 2,605 ft. Casing was set at 2,606 ft. and after drilling the plug the operator had 400 ft. of fluid in the hole, 60 per cent water. Hole was deepened to 2,610 ft. and after treatment with acid swabbed 35 bbl. of fluid per hour for 8 hours with 50 per cent water.

In Ellis County the Texas Co. had a show of oil on a drill-stem test at the 1 Staab "A." Test was made at 3,418-25 ft. and casing has been set at 3,584 ft. in the Arbuckle. Crew is drilling ahead at 3,664 ft.

The Derby Oil Co. 1 Lang, SW SW NE 32-13s-17w, also in Ellis County, with total depth of 3,667 ft. and casing set at 3,584 ft. was planning to plug back and test the Lansing-Kansas City.

In the western part of the state, Stanolind Oil & Gas Co. 1 Bear, NW NW SE 17-32s-40w, Morton County, recovered only mud on a drill-stem test at 5,518-88 ft. The Mississippian was topped at 5,499 ft. The 1 Bear had gas in the Pennsylvanian at 4,990-5,017 ft.

The Panhandle Eastern Pipe Line Co. 1 Shafer, C SW 25-32s-39w, deep test for Stevens County in Hugoton field, was dry at 7,184 ft. The markers below the regular Hugoton pay were: Lansing lime, 4,048 ft.; Morrow sand, 5,896 ft.; Chester, 6,045 ft.; Viola lime, 6,886 ft.; Simpson sand, 7,016 ft.; and the Arbuckle at 7,086 ft.

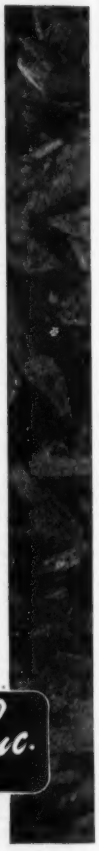
For the week, 34 completions and 28 locations were recorded. Butler County had four completions and four locations followed by Barton with two completions and five locations. Rice had two completions and four locations.

KANSAS WILDCAT FAILURES

Butler County: Shell Oil Co. 1 Henley, SE SE SW 7-24s-8e, dry, TD 2,730 ft., no tops reported.

Graham County: Bennett & Roberts &

Sour Gas!



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Tulsa 1 Oklahoma

Wilcox 1 Jenkins, SE SW NE 33-6s-21w, dry, 3,770 ft., Heebner 3,426 ft., Lansing 3,453 ft., Arbuckle 3,724 ft., with show of dead oil.

Appleman & Veeder 1 Newell, SE SE SE 35-8s-21w, dry, TD 3,756 ft., Lansing 3,381 ft., show of oil 3,459-63 ft. and 3,465-68 ft., Arbuckle 3,726 ft.

Pratt County: Harber & Apex 1 Danbury, NW NW NW 18-28s-12w, dry, TD 4,675 ft., first Lansing 3,776 ft., second Lansing 3,833 ft., Mississippian 4,292 ft., show of oil 4,414 ft., Viola 4,416 ft.

Rice County: Bennett & Roberts Drilling 1 Willhaus, SW SW NW 6-21s-6w, dry, TD 3,540 ft., conglomerate 3,457 ft., Mississippian 3,483 ft., Kinderhook 3,530 ft.

Rooks County: Rine Drilling Co. 1 Baxter, NE NE NW 12-7s-19w, dry, TD 3,505 ft., anhydrite 1,425 ft., Heebner 3,098 ft., Lansing 3,121 ft., conglomerate 3,446 ft., Arbuckle 3,455 ft.

Stafford County: Huber, Cook & Callaway 1 Mellies, NE NE SE 6-22s-11w, dry, TD 3,617 ft., Heebner 3,068 ft., brown lime 3,188 ft., Lansing 3,202 ft., conglomerate 3,477 ft., Viola 3,521 ft., Simpson 3,565 ft., Arbuckle 3,605 ft.

Sumner County: W. M. Shaw 1 Stahl, SE NE NE 36-34s-1w, dry, TD 2,868 ft., no tops reported.

Woodson County: O. R. Newcomer 1 Fegan, C E/2 SE SW 2-26s-14e, dry, TD 1,535 ft., Bartlesville 1,340 ft., slight show of oil 1,388-1,408 ft., Mississippi lime 1,515 ft.

OHIO, KENTUCKY

Second Clinton Well in Litchfield Area Shows Gas

COLUMBUS.—Carl R. Edson 2 E. H. Miller, Lot 31, Litchfield Township, Medina County, topped the Clinton at 2,891 ft. At 4 ft. in, when it was shut down to pull pipe, it gaged 2,260,000 cu. ft. Drilling will continue when the 6-in. is out of the hole. This is the first and a southwest offset to the discovery well, the Miller 1.

William Pfeiffer 2 Samuel Nofsinger, Section 6, Bethlehem Township, Stark County, extends the Navarre pool a location south and west. White Clinton sand at 4,202-22 ft. made 942,000 cu. ft. natural, 2,000,000 cu. ft. when shut in after shot.

M. B. Belden drilled in his wildcat on A. C. Wales, Section 5, Perry Township, Stark County, with only a show of gas in the Red Clinton at 4,311-16 ft. The gas showing was shot with 70 qt., but it did not increase the volume and the well was plugged. The test is on the north edge of the City of Massillon.

H. E. Perkins 1 Virgil Wolfe, Section 18, Jackson Township, Knox County, a semi-wildcat, drilled through the Clinton at 2,914-68 ft. The well gaged 400,000 cu. ft. natural and was tubed without shooting. To the north, Shuff & Bucy 2 Clare Miller found a nice oil showing in the Clinton which after shot swabbed and flowed 65 bbl. The sand was logged at 3,007-59 ft.

Twenty-seven locations were reported from 10 counties, a high for the year. Perry County led with 8 and was followed by Ashland, Muskingum and Stark with 4 each. Stewart and Ashland wields led in completions, each having 6 out of a total of 26.

OHIO WILDCAT FAILURE

Stark County, Perry Township: M. B. Belden et al 1 A. C. Wales, Sec. 5, Clinton 4,289-4,369 ft., TD 4,478 ft.

WESTERN KENTUCKY

OWENSBORO.—The Pure Oil Co. and associates have asked for contractor's bids on deep test for Webster County. The location is the Pure Oil Co., Ashland Oil & Refining Co., and I. B. Browning 1 M. L. Walker, NE¼ 22-N-24. The objective of the test is about 2,500 ft. in the Knox dolomite, the top of which should be found between 5,000 and 6,000 ft. or a total depth of about 7,500 ft. This will be the first deep test to be drilled just south of the Shawneetown-Rough Creek fault. Plans are to start the well with rotary tools, change to cable for the Mississippi lime, and change back to rotary to finish the hole.

In Hopkins County the George S. Engle, Rex Alworth, and Ashland Oil & Refining Co. 1 Proctor Ashby, 1-K-25, had excellent gas show on a test of the Tar Springs sand. A drill-stem test of pay zone at 2,214-44 ft. got gas at an estimated rate of 4 to 6 million cubic feet per day.

EASTERN KENTUCKY

ASHLAND.—Operations reported in the Eastern Kentucky field during the week

(Continued on page 255)

ILLINOIS

Wabash County Has Three Good Completions

MATTOON.—Wabash County had three good oil-well completions in the Cypress sand last week. The Continental Oil Co. 5 E. E. Seiler, NW NW SW 35-1s-13w, was completed at 2,299-2,317 ft. for an initial production of 110 bbl. per day. Magnolia Petroleum Co. and W. Duncan 1 Lena Bosecker et al, NE SW NE 14-2s-14w, had an initial production of 100 bbl. daily from pay at 2,274-98 ft. The Illinois Mid-Continent 1 G. G. Morris, NW SW SW 35-1s-13w, has an estimated potential of 125 bbl. per day from 2,306-23 ft.

In Lawrence County Hayes Drilling Co. is

waiting on cable tools to test the Benoist, 2,292-2,308 ft., at the 1 Frick & Limp, wildcat located SE SW NE 24-2n-13w. Current total depth is 2,529 ft.

In Hamilton County Kingwood Oil Co. 2 E. O. Muhlenbein, SW NE SE 3-4s-6e, on the west edge of the Belle Prairie pool, has been completed with an initial production of 106 bbl. per day from the McClosky at 3,432-34 ft. Total depth is 3,448 ft.

ILLINOIS WILDCAT FAILURES

Coles County: H. C. Sanders 5 G. Sutton, NW NW SE 36-14n-7e, dry, TD 1,849 ft.

Montgomery County: L. L. Benoist 1 F. Krummel, SW SW SW 12-7n-4w, dry, TD 2,094 ft.

Wayne County: Nation Oil Co. 1 French, SE SE SW 19-2s-8e, dry, TD 3,455 ft.

Hamilton County: Aurora Gasoline Co. 1 H. E. Howard, SW SW NE 7-7s-6e, dry, TD 3,383 ft.

Edwards County: Calvert & Willis 1 F. Root, SW SW SW 9-1s-14w, dry, TD 3,130 ft.

PERMIAN BASIN

First Offset in South Jameson Ready to Test

MIDLAND.—Sun Oil Co. 1 Central National Bank of San Angelo, southwest offset to the Jameson South field discovery, northwestern Coke County, was preparing to test the reef limestone between 6,580-95 ft., total depth. On an elevation of 2,144 ft., the well was reported running 351 ft. lower than the discovery, on top of the Strawn lime section. Sun's discovery well had the pay section between 6,230-60 ft.

Texas Pacific Coal & Oil Co. moved rotary rig off at its 62-D-A John F. Lane, Account 2, and was to run tubing for potential tests. This prospective Ellenburger discovery in the McCamey (Grayburg and Silurian) field of Upton County, plans to test both the Ellenburger and Silurian. Early in the week it flowed 171 bbl. of oil in 12 hours from the Ellenburger at 8,070-8,130 ft. Location is NE SE Section 5, GC&SF Survey, and 990 ft. west and 330 ft. north of Texas Pacific's 52-A Lane, only Silurian producer in the area, which failed in the Ellenburger.

In southwestern Ector County, Humble Oil & Refining Co. 3 Yarbrough & Allen became the field's fourth producer and extended production ½ mile south. The well made daily flowing potential of 280.2 bbl. of 41.5°-gravity oil from open hole between 10,810-10,840 ft., total depth, after washing with 500 gal. of mud acid.

In northwest Martin County, Stanolind Oil & Gas Co. 1 J. E. Mabee had total depth at 12,150 ft., in a section tentatively identified as the Fusselman zone of the Silurian. On an elevation of 2,880 ft., one report places top of the Fusselman at 12,130 ft. A core from 12,140-150 ft. showed some oil odors and slight oil stains. Operators were to run a drill-stem test of the section. Location is 660 ft. from south and west lines of Tract 87, League 258, Briscoe CSL Survey, and about 35 miles northwest of the town of Stanton.

Stanolind 1 E. M. Nix et al, Section 21, Block A-47, Andrews County wildcat 2½ miles south of the Fullerton area, placed top on the Ellenburger at 11,489 ft., and after coring from 11,490-499 ft., was to take a drill-stem test. Official report on this core was not available, but it was reported that it recovered some dolomite, which might be Ellenburger, but possibly some Simpson material, which would place it in the detrital zone above the Ellenburger. If 11,489 ft. is top of the Ellenburger, then on its elevation of 3,277 ft., it would be running 468 ft. high to Placid Oil Co. 1 M. A. Thornberry, Section 5, Block A-42, PSL Survey, Ellenburger discovery 2½ miles to the southeast.

C. W. Chancellor, Slick Oil Co. et al 1 Thornton Davis, Pecos County discovery, perforated casing in the Ellenburger with a total of 1,100 holes between 9,100-9,700 ft. and were preparing to run a production test of the section.

Sixteen wildcat locations and 67 field starts were made last week, compared with 8 wildcats and 83 in fields the previous week. Counties gaining new exploratory tests are: Pecos and Runnels 2 each; Coke, Cochran, Ector, Hockley, Kimble, Regan, Reeves, Scurry, Terry, Upton, Ward and Winkler counties, 1 each. Total locations this week, by counties, were: Pecos 13, Hockley 10, Scurry 8, Winkler 8, Crane 6, Gaines 6, Ector 6, Crockett 5, Regan 4; Howard, Mitchell, Terry and Schleicher 2 each; and 1 each in Cochran, Coke, Upton and Ward. Completions for the week were 50 oil wells and 3 failures, including the 1 dry wildcat.

WEST TEXAS (DISTRICTS 8 & 7-C) WILDCAT FAILURES

Crockett County: Hunt Oil Co. & Moore Exploration Co. 1-D University, Sec. 26, Blk. 12, University Lands, 7 mi. S Big Lake, dry, TD 2,562 ft. in sand, had hole full of water, top limestone 2,382 ft., elev. 2,705 ft.

Hockley County: Ralph Lowe 1 E. T. Roch, Labor 28, League 26, Wharton CSL Sur., 7 mi. SE Levelland, dry, TD 5,275 ft., San Andres 4,180 ft., elev. 3,506 ft.

TEXAS PANHANDLE (DISTRICT 10) WILDCAT FAILURE

Collingsworth County: Portman & Jenkins 1 Scruggs, Sec. 5, Blk. 17, H&GN Sur., 3 mi. S Shamrock, dry, TD 2,206 ft., in pre-Cambrian, show gas 1,891-92 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—Barnsdall Oil Co. was preparing for completion tests in the regular pay zone of the Monument field, in its 9 Alaska-Cooper, NE NE 12-20s-36e, after finding no shows of oil or gas in drilling

(Continued on page 256)

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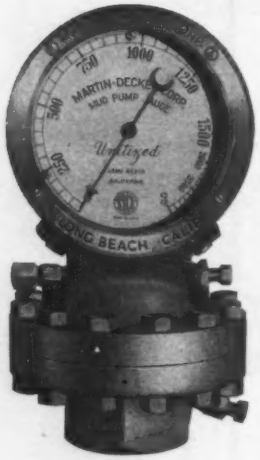

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Completions Up 8 Per Cent and Footage Up 7 Per Cent Over Last Year

by Polly De Armond

THE number of completions in February totaled 2,403, a gain of 184 wells or 8.3 per cent over February of 1947. Oil and gas producing completions represented a gain of 7.6 per cent, while dry holes increased 9.5 per cent, and total footage of almost 8.5 million feet was up 6.7 per cent over the corresponding month of the previous year. By depth classifications, the number of wells drilled over 10,000 ft. increased 51 per cent, the group under 2,500 ft. reported an increase of 4.3 per cent, the 2,500-5,000-ft. group reported an increase of 10.3 per cent, and the combined ranges of 5,000-10,000 ft. reported an increase of 7.4 per cent.

These gains for the month, attained despite unexpectedly severe winter weather conditions, appear to substantiate the over-all forecast of some 36,600 total wells and 131,755,000 ft. to be drilled in 1948, made by The Oil and Gas Journal in the Annual Issue of January 29, 1948.

Yearly Trend Comparison

Comparisons of the first 2 months of the current and previous years reflect the normal seasonal trend of completions as a whole. Total wells drilled for January-February 1948 reached 5,480, an increase of 519 wells or 10.5 per cent over the 4,961 completions for the same period in 1947. In a breakdown of this period's figures, 3,139 oil wells represented a 16 per cent increase over last year, while dry holes moved up to 1,922 or 12.6 per cent gain, with gas wells decreasing from 551 to 419 or 23.9 per cent.

Total footage for January-February was 19,458,130 ft., a 10 per cent gain over the 17,689,913 ft. for last year, represented by a 16 per cent gain in wells over 10,000 ft., a 15 per cent gain in the 5,000-10,000-ft. group, a 13 per cent gain in the 2,500-5,000-ft. classification, and an 8 per cent gain in wells under 2,500 ft.

Sectional Comparison for Period

In the 2-month comparison periods, the increases over 1947 were: the Texas-New Mexico area with 14.9 per cent more wells and 12.7 per cent more footage; the North Central area of Ohio, Indiana, Illinois, Kentucky and Michigan up 15.4 per cent in completions and 10.4 per cent in footage; the Southern area of Arkansas, Louisiana, Mississippi, Alabama, Georgia and Florida with a 31 per cent gain in wells and only 7.4 per cent in footage due to an increase in very shallow completions; the Rocky Mountain area with a 77.6 per cent increase in completions and a 108 per cent increase in footage; California up 16.3 per cent in completions and 12.5 per cent in footage.

SUMMARY OF COMPLETIONS, FEBRUARY 1948

	Comp.	Oil	Prod.	Gas	Dry	Under 2,500 ft.	2,500-5,000 ft.	5,000-7,500 ft.	7,500-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	124	62	131	0	62	124	0	0	0	0	176,948	160
Pennsylvania	212	104	229	15	93	167	43	0	2	0	347,855	261
West Virginia	‡48	7	37	‡34	7	‡29	17	2	0	0	116,119	211
Ohio	78	21	396	24	33	28	49	1	0	0	227,709	186
Indiana	76	45	3,212	4	27	68	8	0	0	0	135,321	76
Kentucky	37	13	800	5	19	30	7	0	0	0	56,453	57
Illinois	176	99	8,460	0	77	42	134	0	0	0	466,434	206
Michigan	44	15	3,296	2	27	21	23	0	0	0	101,549	98
Kansas	191	97	33,364	23	71	21	168	2	0	0	614,164	354
Neb., Mo., Iowa	0	0	0	0	0	0	0	0	0	0	0	11
Oklahoma	252	146	17,104	16	90	85	118	40	5	4	902,707	604
Texas	692	450	86,672	32	210	155	285	169	63	20	3,133,002	1,011
North	116	67	7,009	3	46	56	46	14	0	0	354,722	151
West Central	81	41	4,606	3	37	21	54	6	0	0	278,940	58
West	185	163	54,859	1	21	37	86	34	24	4	848,111	136
Panhandle	34	19	2,369	12	3	3	31	0	0	0	102,885	155
Eastern	34	19	2,850	3	12	2	13	11	7	1	201,400	89
Gulf Coast	115	72	8,297	3	40	6	29	45	23	12	733,584	202
Southwest	127	69	6,682	7	51	30	26	59	9	3	613,360	220
Louisiana	119	75	8,966	7	37	47	19	7	21	25	662,818	199
Northern	65	44	4,160	5	16	46	9	4	6	0	189,825	50
Southern	54	31	4,806	2	21	1	10	3	15	25	472,993	149
Arkansas	21	11	1,122	0	10	3	12	3	3	0	95,668	28
Mississippi	31	19	5,506	1	11	0	1	6	8	16	281,019	45
Ala., Ga., Fla.	2	0	0	0	2	0	2	0	0	0	6,962	5
Montana	13	10	657	0	3	3	8	2	0	0	41,937	69
Wyoming	20	14	3,083	0	6	1	16	3	0	0	80,342	34
Colorado-Utah	18	11	1,870	0	7	4	1	12	1	0	94,151	94
New Mexico	32	22	4,012	6	4	4	18	9	1	0	139,326	122
California	217	185	26,386	3	29	79	76	26	33	3	765,491	404
Total Feb. 1948	2,403	†1,406	204,303	172	*825	911	1,005	282	137	68	8,445,975	4,235
Total Jan. 1948	3,077	1,733	279,423	247	1,097	1,150	1,307	396	160	64	11,012,155	4,430
Total Feb. 1947	2,219	1,201	211,390	265	753	873	911	390		45	7,912,563	3,620

*Includes 161 service wells: N. Y. 62, Pa. 86, Ohio 8, Ind. 3, Kans. 1, Okla. 1, †Includes 21 distillate wells: E. Tex. 1, Tex. Gulf 9, S. W. Tex. 1, No. La. 4, So. La. 5, Miss. 1. ‡Includes 1 Virginia completion.

Automatic Octane Booster

(Continued from page 104)

It has been established* that tetraethyl lead actually reduces the antiknock quality of alcohols when these alcohols are used as a primary fuel. It has also been shown that in leaded gasoline containing minor amounts of alcohol, both the alcohol and tetraethyl lead contribute to the antiknock quality achieved. This is also illustrated in Fig. 3 where the effect of the lead is shown as a reduction in the alcohol concentration needed for a given antiknock effect.

Antidetonant Burning Quality

The clean-burning quality of fuels has long been recognized as an asset in heating equipment, but its value in internal-combustion engines has been recognized and measured only over the past few years. This is mentioned here as of special significance when considering the addition of an antiknock material to a fuel-air charge.

Lower-molecular weight alcohols have an infinite burning quality on any scale ever set up to measure this property of fuel. Hydrocarbons will burn to soot and show marked differences according to type and boiling point. The paraffins are best, but none of them even approach alcohol in ability to burn to nothing but gaseous products of combustion over a wide range of temperatures and fuel-air ratios. Possibly this is because an atom of oxygen is already attached to an atom of carbon with that carbon atom in effect being already converted to carbon monoxide.

When a combustible antidetonant is added to a fuel-air charge, it is important that the resulting rich mixture does not cause a loss in power and does not produce the engine-fouling soot and resins from which hydrocarbon-air ratios. Alcohol-base antidetonants can be added to the fuel-air charge delivered by a conventional carburetor with an increase in burning cleanliness rather than a decrease. Without this quality in an antidetonant, installation of the flange-mounted Vita-Meter without carburetor alterations would not be practical.

Hydrocarbon Antidetonants

Hydrocarbons with high road-octane-number blending values can be useful antidetonants in a system which administers them when needed. However, when they are injected the main fuel supply must be cut back proportionately to avoid a total mixture which is too rich and in order to utilize the high heating value of the hydrocarbon antidetonant.

Some carburetors are already designed with a separate power jet which supplies additional gasoline at or near full throttle. It is a relatively simple thing to have a carburetor-mounted Vita-Meter unit serve as the power jet and to supply the hydrocarbon antidetonant in amounts up to 20 per cent of the total. At the percentages shown, the response of two hydrocarbon antidetonants and a methanol solution are shown in Fig. 4.

In Fig. 4, the 59-road-octane-number straightrun gasoline had an A.S.T.M. motor method octane number of 59. Gasoline R had a road octane number of 80, an A.S.T.M. motor method octane number of 76, and a research method number of 84 and it contained 1 cc. of TEL per gallon. A 1946 Chevrolet was used to obtain the road octane numbers of the base gasolines and the blends. The hydrocarbon points in Fig. 4 are shown as percentages of total gasoline but the alcohol antidetonant percentages shown are in addition to gasoline.

Because of the many variables involved it is not possible to state a cost per octane number per gallon of gasoline burned that will be applicable to all types of service. Enough experience has been gained, however, to show that a considerable antiknock-quality gain is available at costs which are competitive with and in many cases cheaper than refinery methods. The one large task remaining to us is to learn the optimum increment of antiknock quality to be reached in each type of service. This must largely come from tests in actual operation.

The fact that gasoline can be a source of engine varnish and sludge was first pointed out by H. C. Mougey* who shows a comparison between gasoline A and gasoline C after an identical engine test on identical motor oils. Gasoline A was a cracked material high in olefins and aromatics and gasoline C was a light, paraffinic fuel. The difference in ring plugging is especially marked.

High-Compression Engines

The 10 to 20 road octane numbers available by using antidetonant injection with today's regular and premium gasolines ranks in importance with the discovery and commercial application of tetraethyl lead.

The lesson for us here is that people in present-day cars should be offered an injector unit and have the antidetonant solution available to them at service stations.

The requirement for selling to vehicles now on the road almost rules out a high-blending-value hydrocarbon like diisobutylene. This is not because of lack of suitability technically, but its use would require new carburetors, or major alterations to old carburetors to diminish the main gasoline supply when the supplementary fuel was injected.

The principal of using antiknock quality only when needed is also applicable to a system which utilizes two full gasolines of different octane levels. The use of such a system without the distribution of a third grade of gasoline would require that premium gasoline in service stations be raised to satisfy the peak octane requirements of the new, high-compression-ratio cars. This high-octane gasoline would be sold in substantial quantities to people now buying premium gasoline and would result in the high investment requirements for refinery equipment so well pointed out in William M. Holaday's S.A.E. paper.* If the market for the new premium gasoline were made smaller by raising the price, total earnings from this grade of gasoline would be diminished.

*"Octane Ratings of Agricultural Motor Fuels," by C. F. Elder, F. R. Truby and R. Wiebe. Ind. and Chem. Eng., April 1947.

*"Piston Lacquering, Its Causes and Cure," by H. C. Mougey, Research Laboratories Division, General Motors Corp. Presented at the S.A.E. annual meeting, Detroit, January 8-12, 1945.

*"The Efficient Production and Utilization of Motor Gasoline" by W. M. Holaday, director, Socony-Vacuum laboratories. Paper presented at the S.A.E. annual meeting, Detroit, January 12-16, 1948. Also see The Oil and Gas Journal, January 22, 1948, p. 129.

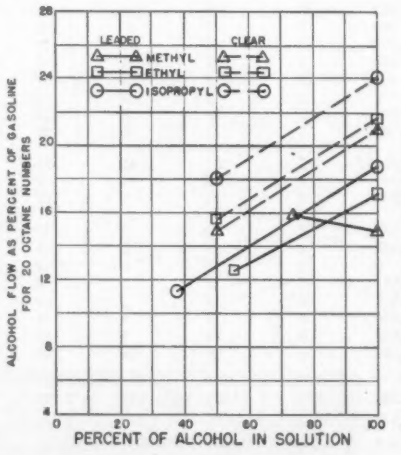


Fig. 3—Effectiveness of alcohol-water antidetonants

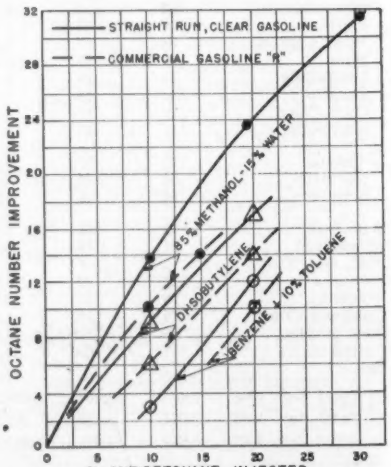


Fig. 4—Antiknock value of antidetonants

EQUIPMENT MEN ... in the News

New Arkansas Office Established

Thompson-Hayward Chemical Co., Kansas City, has recently purchased a warehouse at 123 South Main Street, North Little Rock, Ark. This new branch office and warehouse, under the management of Robert F. Wagner, will provide a more convenient source of supply and assure more rapid delivery service for Thompson-Hayward customers in central and northern Arkansas.

Toben to Rocky Mountain Area

Cardwell Manufacturing Co., Wichita announces the appointment of Alexander A. Toben as sales representative for the Rocky Mountain area to include the states of Colorado, Wyoming, Utah, and Montana. Toben is a graduate engineer with considerable practical experience, having for 7 years been associated with Bishop Oil Co., of California in that capacity. He is well versed in drilling and production methods, and for the past 2 years has been engaged in the sale of heavy industrial equipment on the West Coast.

Toben will make his headquarters in Denver.

Byron Jackson Names Houston Concern

Under a sublicense granted by Byron Jackson Co., Los Angeles, Perforating Guns Co., will provide the Perfo-Jet process to Gulf Coast operators and producers.

The Perfo-Jet process applies the shaped-charge principle used in the wartime Bazooka to gun perforating. New type guns have been developed by B.J. to fire the Perfo-Jet charges.

Perforating Guns Co., has its main offices in Houston.

McRae Named to Sales Post

Appointment of James A. McRae of Houston as Coro-Gard sales engineer has been announced by the adhesives and coatings division of Minnesota Mining & Manufacturing Co., St. Paul.

McRae, introducing the firm's anti-corrosion coating for oil-tank interiors, will concentrate his attention in the Midland-Odessa fields.

McRae, 28, a Marine Corps veteran, first worked in the oil fields summers as a roughneck, while attending Southern Methodist University at Dallas. Postwar, he worked 2 years as a bidder and estimator on oil-field contracting and construction.

Store Manager Changes Announced

Three changes in Oil Well Supply Co. store managers were announced recently.

Elmer E. Rust, warehouseman in the Anson, Tex., store since joining Oilwell in August 1945, has been named manager. He succeeds Ralph Crowe, who has been transferred as manager of the Greggton, Tex., store. J. N. Tate has been appointed manager of the company's Pampa, Tex., store.

Moon to Tulsa

McCord Corp. announces that Al Moon, lubricator division representative in the oil fields, is now located at 310 Thompson Building, Tulsa. Moon's 20 years' experience in the engineering department with McCord Corp. is available to users of mechanical force-feed lubricators and chemical pumps.

Evans Joins Branson Instruments

Dwight J. Evans has joined Branson Instruments, Inc., Danbury, Conn., as chief engineer, in charge of the development of new instruments for the petroleum trade.

After graduating from Kansas University with a bachelor of science in electrical engineering in 1938, Evans was connected with the engineering department of Phillips Petroleum Co., Bartlesville, Okla., from 1939 to 1948. He served in the U. S. Navy as aviation radar officer for 3 years, on military leave from Phillips Petroleum Co.

Johnston Celebrates Twentieth Anniversary

Designed and built by the seven Jonhston brothers while contracting and drilling in Arkansas and Alabama, the Johnston formation tester was first commercially run in Arkansas in May 1928. From there its use quickly spread to Texas, California, the entire domestic oil country, and throughout the world.

M. O. Johnston has played a leading role in this oil-field development throughout the past 20 years. The numerous formation testing accessories he has designed have added greatly to the testing tool's effectiveness. He has also made distinct contributions to casing-packer designs and gun perforators and is now marketing the Johnston "Shoot-N-Test" gun perforator.

Johnston is president of M. O. Johnston Oil Field Service Co., Los Angeles, which handles export sales of the Johnston formation tester and "Shoot-N-Test" gun perforator and heads the Johnston Oil Field Service Corp. in Los Angeles and Houston which service domestic fields.

New Service for Oil Industry

The firm of Lundstrum & Skubic, Inc., architects and engineers, offers a highly technical and specialized service to the petroleum industry in the preparations of plans and specifications and the furnishing of inspection and supervision of complete pipeline and marine terminals, bulk-storage plants, products pipe lines, and pumping stations, warehouses and office buildings, and similar specialized structures pertaining to the marketing of petroleum.

Both principals, John E. Lundstrum, registered structural and professional engineer, and Leroy F. Skubic, registered architect, have had long and valuable experience with one of the larger oil companies and since the organization of their firm have successfully completed several extensive oil-marketing projects. They are now in position to extend the scope of their activities to all those companies engaged in marketing petroleum products who can use their knowledge and talents.

STATISTICS and

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 20, 1948

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1948				
	Comp.	Oil	Gas	Dry	Footage	1948	1947	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	28	14	0	*14	31,129	345	311	0	0	0	0	0	0	0	0	0	0
Pennsylvania	47	20	6	†21	92,038	636	724	0	0	1	0	1	0	0	4	10	14
West Virginia	16	0	15	1	46,690	159	193	0	0	2	1	3	2	0	13	17	32
Ohio	28	11	11	‡6	78,000	253	265	0	0	0	1	1	1	0	3	8	12
Indiana	12	9	0	3	25,939	196	95	1	0	0	0	1	2	0	0	2	4
Kentucky	7	1	2	4	7,710	135	88	0	0	0	0	0	1	0	0	3	4
Illinois	27	16	0	11	71,980	441	434	0	0	0	5	5	10	0	0	72	82
Michigan	9	3	0	6	19,644	151	134	0	0	0	4	4	5	0	4	61	70
Kansas	34	19	0	15	106,216	601	584	0	0	0	9	9	8	0	1	74	83
Neb., Mo., Iowa	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Oklahoma	69	43	1	25	226,979	817	897	3	0	0	11	14	28	3	6	138	175
Texas	199	134	5	60	874,645	2,251	1,792	3	1	0	23	27	69	6	20	411	506
North Central (Dist. 7-B & 9)	65	34	1	30	189,993	676	546	2	0	0	7	9	28	0	4	130	162
West (Dist. 7-C & 8)	53	50	0	3	274,685	602	447	0	0	0	1	1	10	0	1	41	52
Panhandle (Dist. 10)	15	10	2	§3	44,308	121	103	0	0	0	1	1	0	0	1	3	4
Eastern (Dist. 5 & 6)	7	5	1	1	41,938	117	102	0	0	0	1	1	3	0	0	33	36
Gulf Coast (Dist. 2 & 3)	29	17	1	11	203,465	370	344	1	1	0	6	8	19	5	4	98	126
Southwest (Dist. 1 & 4)	30	18	0	12	120,256	365	250	0	0	0	7	7	9	1	10	106	126
Louisiana	37	24	0	13	210,217	398	246	0	0	0	9	9	7	4	1	41	53
Northern	22	17	0	5	59,635	254	116	0	0	0	3	3	0	0	0	20	20
Southern	15	7	0	8	150,582	144	130	0	0	0	6	6	7	4	1	21	33
Arkansas	2	1	0	1	6,952	75	49	0	0	0	1	1	2	0	0	20	22
Mississippi	4	1	0	3	28,950	90	78	0	0	0	2	2	2	0	0	19	21
Southeastern States	2	0	0	2	6,419	9	12	0	0	0	2	2	0	0	0	8	8
Montana	4	4	0	0	13,770	56	38	0	0	0	0	0	1	0	0	7	8
Wyoming	6	4	0	2	20,773	82	53	0	0	0	2	2	5	0	0	9	14
Colorado-Utah	2	2	0	0	12,878	60	34	0	0	0	0	0	0	0	0	9	9
New Mexico	12	7	1	4	53,056	137	107	0	0	0	2	2	2	1	0	8	11
California	42	32	0	10	126,471	589	442	0	0	0	7	7	5	0	0	61	66
Total United States	587	345	41	201	2,060,456	7,481	6,578	7	1	3	79	90	150	14	52	978	1,194
Total previous week	611	361	45	205	2,301,619	6,894	6,070	17	4	8	73	102	143	13	49	899	1,104
Total March 22, 1947	508	272	63	173	1,758,087			12	0	3	62	77	134	17	32	825	1,008

Service wells included: *14, †20, ‡2, §1.

CRUDE PRICES AND REFINERY ACTIVITY

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$2.17	....	....	....
19-19.9	2.19	....	....	....
20-20.9	2.21	$2.25	....	$2.12
21-21.9	2.23	2.27	....	2.14
22-22.9	2.27	2.29	....	2.16
23-23.9	2.30	2.31	....	2.18
24-24.9	2.34	2.33	$2.56	2.20
25-25.9	2.38	2.35	2.58	2.22
26-26.9	2.41	2.37	2.60	2.24
27-27.9	2.45	2.39	2.62	2.26
28-28.9	2.49	2.41	2.64	2.28
29-29.9	2.52	2.43	2.66	2.30
30-30.9	2.56	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.62	2.49	2.72	2.36
33-33.9	....	2.51	2.74	2.38
34-34.9	....	2.53	2.76	2.40
35-35.9	....	2.55	2.78	2.42
36-36.9	....	2.57	2.80	2.44
37-37.9	....	2.59	2.82	2.46
38-38.9	....	2.61	2.84	2.48
39-39.9	....	2.63	2.86	2.50
40 and above	....	2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point. †Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT WEEK ENDED MARCH 13

(Thousands of barrels)

District—	Crude runs, daily avg.	Production: Gasoline†	Kerosine	Gas & dist. oil	Residual	Stocks at refineries, bulk terminals, in transit and in pipe lines: Gasoline*	Kerosine	Gas & dist. oil	Residual
East Coast	882	2,053	384	1,392	1,865	22,414	3,390	7,274	7,361
Appalachian:									
District 1	95	298	70	98	91	2,203	171	327	323
District 2	59	167	26	62	115	1,020	108	208	106
Ind., Ill., Ky.	845	2,805	436	1,058	1,128	20,796	1,591	3,819	3,361
Okla., Kans., Mo.	428	1,366	231	545	511	11,006	508	1,842	1,414
Inland Texas	245	1,009	99	193	404	4,311	254	295	814
Texas Gulf Coast	1,357	3,631	748	2,393	1,916	20,510	1,527	4,890	5,658
La. Gulf Coast	398	1,197	378	652	575	5,900	814	1,694	1,798
N. La. and Ark.	79	187	60	101	120	2,236	253	310	193
Rocky Mountain:									
New Mexico	8	21	4	7	20	107	25	18	28
Other Rocky Mtn.	155	439	33	200	279	3,247	106	680	696
California	856	2,435	78	1,053	2,268	18,168	930	10,751	26,794
March 13, 1948	5,407	15,608	2,547	7,754	9,292	111,918	9,677	32,108	48,546
March 6, 1948	5,311	15,451	2,821	7,354	8,700	111,474	9,843	32,749	48,114
March 15, 1947	4,928	15,005	2,190	5,937	8,833	104,824	10,601	33,269	43,217

*Finished and unfinished. †At refineries including natural blended.

Bureau of Mines crude-oil stocks 219,713,000 bbl. as of March 13—up 138,000 bbl. One year ago 222,341,000 bbl.

FLAT CRUDE PRICES

Representative posted schedules per bbl.

East Texas	$2.65
Kettleman Hills, California*	2.14
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	5.00
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above.

TRENDS

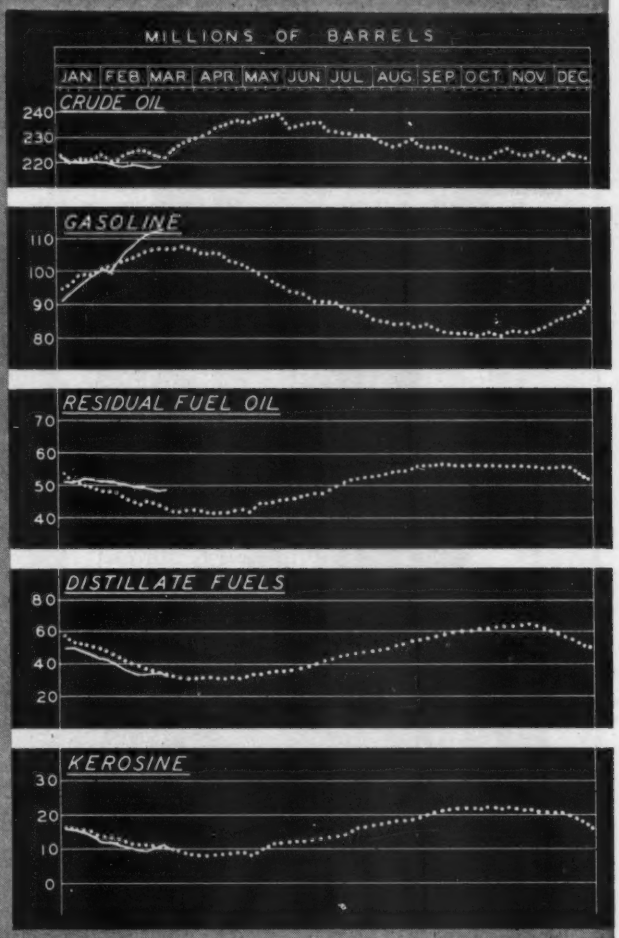
DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 20 crude oil	B. of M. Mar. demand	Mar. 13 crude oil
Alabama	1,350	1,500	1,400
Arkansas	87,450	83,000	87,450
California	946,700	930,000	933,900
Colorado	46,700	48,000	45,980
Eastern	64,800	64,900	62,950
Florida	850	1,000	825
Illinois	168,700	180,000	167,500
Indiana	17,000	16,000	16,900
Kansas	171,350	304,000	199,300
Kentucky	24,400	26,000	25,100
Louisiana	476,150	474,000	476,100
North Louisiana	122,500	.....	122,450
South Louisiana	353,650	.....	353,650
Michigan	45,700	46,000	45,900
Mississippi	119,260	116,000	112,460
Montana	24,120	24,000	24,730
Nebraska	450	600	400
New Mexico	128,950	128,000	128,950
Oklahoma	395,750	410,000	407,100
Texas	2,400,675	2,400,000	2,400,675
Dist. 1 (Southwest)	25,475	.....	25,475
Dist. 2 (Southwest)	170,350	.....	170,350
Dist. 4 (Southwest)	253,200	.....	253,200
Dist. 3 (Gulf Coast)	491,350	.....	491,350
Dist. 5 (Eastern)	43,350	.....	43,350
Dist. 6 (Eastern)	121,225	.....	121,225
East Texas Field	323,000	.....	323,000
Dist. 7-C (West)	43,850	.....	43,850
Dist. 8 (West)	666,700	.....	666,700
Dist. 7-B (W. Central)	43,100	.....	43,100
Dist. 9 (N. Central)	135,675	.....	135,675
Dist. 10 (Panhandle)	83,400	.....	83,400
Wyoming	142,050	137,000	138,010
Total United States	*5,262,405	5,390,000	5,275,630
Change from prev. wk.,	dn. 13,225		

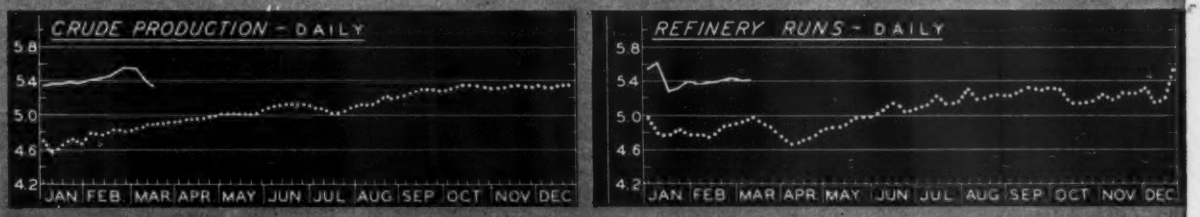
Total production January 1-March 20..... †431,631,550 bbl.
Same period last year (crude plus cond.).. 376,720,895 bbl.

*Not incl. 53,860 bbl. condensate. †Incl. 4,039,215 bbl. condensate.

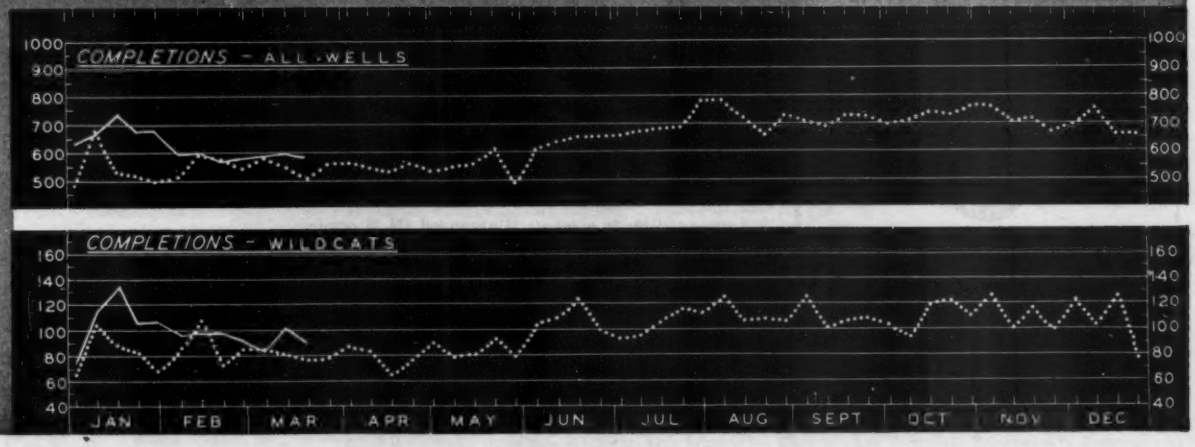
STOCKS IN UNITED STATES



DAILY OPERATIONS

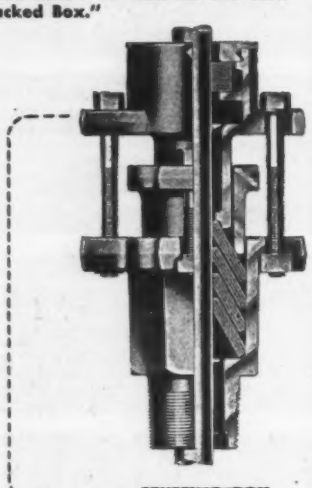


WEEKLY COMPLETIONS

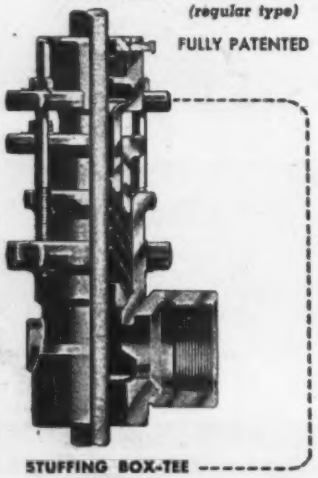


"CONE PACKING"
CAN STAND THE GAFF

When the going is toughest, Operators turn to Hercules . . . it has been tested and accepted in every oil producing field as Standard. Hercules "Cone Packing" has successfully withstood over 2000 pounds pressure . . . has cut packing costs 75% and more in many instances . . . eliminates wabblers . . . is automatically lubricated . . . won't burn out if well pumps off . . . protects polish rod against excessive wear . . . is easy to install and is moderate in price. Next time . . . "Ask for the Cone Packed Box."



STUFFING BOX
(regular type)
FULLY PATENTED



STUFFING BOX-TEE
(T-base type)

Sold at all supply stores.

HERCULES TOOL TULSA

HERCULES
TOOL COMPANY
TULSA, OKLAHOMA, Box 286
EXPORT OFFICE: 30 Rockefeller Plaza
NEW YORK, U.S.A.
CABLE ADDRESS: HERTOCO

MARKETS

IN the Mid-Continent area a strong demand for gasoline was evident with no increase in the price level being reported. Some spot-market movements of gasoline were quoted at 12 cents per gallon. One marketer said that he was offered house-brand gasoline at 10½ cents per gallon if he would make available to the seller the same number of cars that the buyer was using in moving the products purchased.

Because of the generally good weather over the Mid-Continent area the tank-car situation was reported as showing some signs of easing up. However, one marketer pointed out that now is a transitory period in which the bulk of the traffic is being switched from winter season burning oils to heavy shipments of gasoline, and that this condition will add pressure to the tank-car situation.

No. 6 Brings $2.75

One marketer reported moving some No. 6 at $2.75 while another source said that he had sold several cars at $2.85. Natural gasoline, grade 26-70, remained strong and no change in price levels for this product were indicated. Kerosine demand in the Mid-Continent area continued strong.

The tight "pinch" that was so keenly felt this winter through the scarcity of No. 2 burning oil will merely change to gasoline this summer, one supplier observed. For the most part suppliers were of the opinion that supply will be adequate though a few spot shortages may appear.

One source, in looking forward to the supply of burning and heating fuel for the winter season of 1948-49, said that he expected a considerable improvement over the past season. He indicated that even now storage is being prepared to meet the heavy demand for heating fuels when that time comes.

In the Houston area continued softness was noted last week in spot-market trading in most petroleum products. No. 2 was reported moving at prices ranging up to 11½ cents, and kerosine from 12½ to 13 cents in some transactions. Top for regular gasoline appeared to be about 12 cents.

Strike Strengthens No. 6

Possibility of a prolonged coal strike seemed to be providing some strength for the weak market in No. 6 industrial fuel oil. Suppliers with storage were said to be holding material on the likelihood of a tight market. One unconfirmed report said an offer of $3.25 had been refused for a cargo of No. 6.

Quotations on open-market offerings of both light and heavy fuel oils continued to show signs of easing in New York Harbor. However, the majority of independent suppliers said that they did not contemplate any reductions in quotations to regular customers until supply more equally balanced demand and they no longer had to purchase spot material to meet commitments.

Prices generally along eastern seaboard were unchanged. Production is continuing strong on kerosine and heating oil in the East Coast and Gulf Coast areas, according to the East Coast Petroleum Regional Advisory committee.

It was reported that large quantities of heating oil and kerosine have have been made available to state fuel oil coordinators to relieve acute shortages in the New England, New York Harbor, Albany, Philadelphia, and Baltimore areas.

Representative Quotations

Representative spot-market quotations of leading suppliers as of March 22, 1948. Figures are f.o.b. plant for tank-car shipment in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor	Texas Gulf Coast
Regular gasoline, 73-75 octane	10½-11½	11.6-12* 10.5-12.2†	10.9-12
Premium gasoline, 78-80 octane	11¾-12½	10.6-13.4	12.9-13
42-44 w.w. kerosine	10-10½	10.2-12.2	10¼-13
No. 2 straw fuel oil	9⅛-11	9.3-11.1	9.05-11½
No. 6 residual	$2.50-3.00	$3.03-3.90	$2.56-3.00

*Branded (74-76 octane); †Unbranded (74-76 octane).

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	8½	8	8¼
Grade 18-55	10.2	9.6	9.9

LUBRICATING OILS
South Texas

200 vis., No. 2-3 neutral	13-14.5
750 vis., No. 3-4 neutral	15-17.25
2,000 No. 5-6 neutral	17-18½

LUBRICATING OILS
Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	20-23
200 vis. No. 3 neutral, 0-10 pp.	20-21

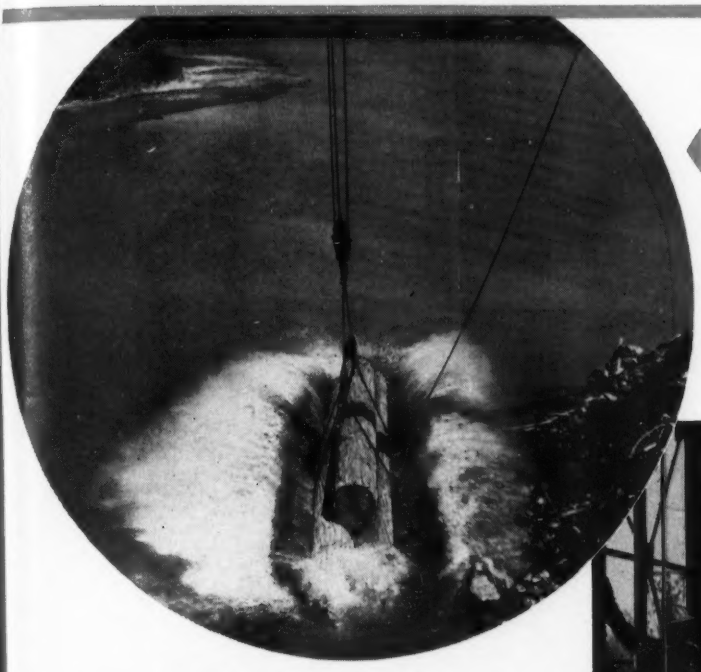
Western Pennsylvania

145-155 vis. 10 p.t. br ght stock	47
180 vis. p.t. neutral	45

CRUDE-bCALE WAX
Mid-Continent

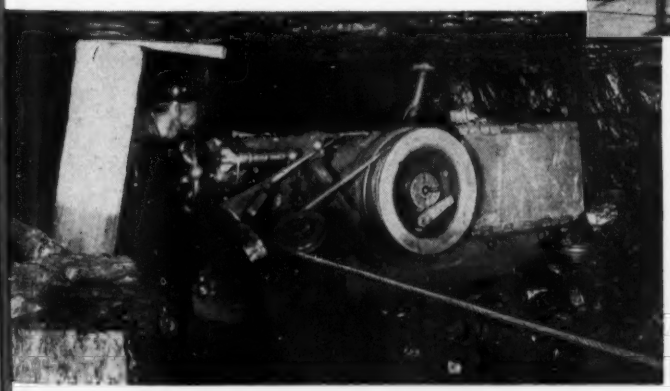
130-132 A.S.T.M. melting point	8¼-8½

Improving Production with LAY-SET PREFORMED



Dropping logs into the river with a swing boom unloader. When logs hit water an automatic trip on the hooks frees the mainline straps. Buoyancy of logs in water slacks the mainline, and weight jerks hooks free from strap loops. With a load of 5,000 board feet (40,000 pounds), that's a lot of lifting, jerking and quick-slackening for the wire rope—but Hazard LAY-SET Preformed takes it in stride.

In oil drilling—Improved production with LAY-SET Preformed wire rope is quickly evident in the oil fields. Because LAY-SET is a "relaxed" wire rope, it takes bending stresses, whipping and straining—with ease. The result is fast, uninterrupted production—more barrels of oil per day.



Short wall cutting machine at work in a coal mine. Here, where wire rope failures would seriously affect production, operators depend upon LAY-SET Preformed wire rope. Its longer life means steadier, more profitable production.

***LAY-SET** Preformed wire rope will improve production on your lifting and pulling jobs too. Be sure to specify* LAY-SET Preformed *the next time you need wire rope.*

ACCO *In Business for Your Safety*

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A DIVISION OF AMERICAN CHAIN & CABLE

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Wilkes-Barre, Pa., Chicago, Pittsburgh, Houston, Wichita, San Francisco, Denver, Los Angeles, Bridgeport, Conn.

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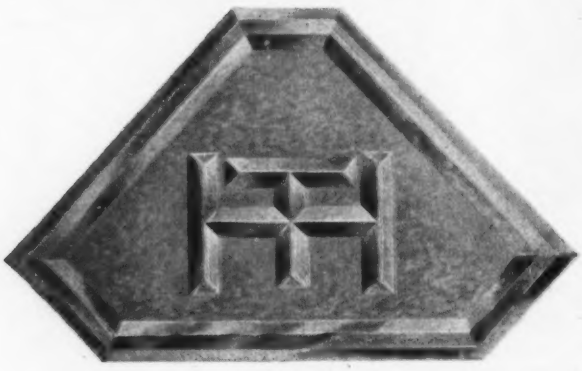

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